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ABSTRACT

Building owners and managers can use performance-contracting Energy Service Companies (ESCOs) to partially or fully fund building renovations that include energy efficiency upgrades. This report provides building owners and managers with an introduction to the energy efficiency and building upgrade services provided by ESCOs. It uses 20 case studies to describe the types of services that ESCO provides, how ESCO performance contracts work, and reasons that building owners and managers choose to use ESCOs to acquire increased energy efficiency and building upgrades. Additional information includes a lists of key Energy Fitness Partner contacts and Department of Energy Fitness Program Partner contacts and web sites for each. (GR)

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(ONE OF THE ENERGY STAR PARTNERSHIPS)

Energy Savings Performance Contract Case Studies

By

Jessica S. Lefevre
for
National Association of Energy Service Companies

October 1997

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FOREWORD

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The Purpose of This Report

This report was prepared to provide building owners and managers with an introduction to the energy efficiency and building upgrade services provided by Energy Service Companies (ESCOs). The report uses twenty case studies to describe the broad range of services that ESCOs provide to their customers, how ESCO performance contracts work, and the reasons that building owners and managers choose to use ESCOs to acquire increased energy efficiency and building upgrades. The case studies include schools, hospitals, factories, hotels, stores, universities, a wastewater treatment facility, and other types of facilities.

The report was prepared for the DOE Energy Fitness Program by the National Association of Energy Service Companies (NAESCO). The DOE Energy Fitness program is one of the Energy Star Partnerships. Your comments and suggestions are welcome. Please provide any comments and suggestions to one of the Energy Fitness Program contacts listed at the end of this foreword.

Introduction to the DOE Energy Fitness Program

The Energy Fitness Program is devoted to increasing the delivery of energy efficiency, new high-efficiency technologies, and renewables by Energy Service Companies (ESCOs) in the nonfederal sectors of the economy. These sectors include state government organizations, local government organizations, private companies and other nongovernment organizations. The ongoing restructuring in the electric and natural gas industries is creating an environment where ESCOs are becoming an ever more important vehicle for delivering energy efficiency, new high-efficiency technologies, and renewables in the competitive marketplace.

Building owners and managers can use performance-contracting ESCOs to partially or fully fund renovations by folding them into a larger project that includes energy efficiency upgrades. ESCO projects can include nonenergy renovations as well as measures to improve efficiency. These projects can be customized for each customer's particular needs. The Energy Fitness Program works with ESCOs, public and private ESCO customers, and other interested organizations to identify and remove barriers to increased delivery of energy efficiency by ESCOs. The Energy Fitness Program is one of the Energy Star Partnerships.

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FOREWORD

Background

Commercial and industrial companies and state and local governments spend $50 billion a year to renovate buildings. The Energy Fitness Program is designed to make sure that this money leverages the installation of as much energy-efficient equipment as possible by helping performance-based ESCOs educate customers about how energy and maintenance savings can be used to fund their renovations. ESCOs design, install, finance, operate, and maintain energy improvement projects in buildings.

ESCOs already install between $700 million and $1 billion worth of energy-efficient equipment each year. This investment in energy efficiency saves the United States $400 to $600 million each year in energy costs. By redirecting this portion of customer spending from energy purchases to energy efficiency improvements and core business spending, these ESCO projects create jobs, expand economic activity, and enable American businesses to become more competitive. Tax burdens decrease due to lower tax rates associated with expanded economic activity and lower revenue requirements when public building renovations are financed with private capital. The energy efficiency measures installed by ESCOs also reduce environmental emissions. The Energy Fitness Program is working to increase these benefits by increasing the delivery of energy efficiency by ESCOs.

Approach

The Energy Fitness Program works toward achieving its goals through partnerships with providers of ESCO services, customers of these services, and other organizations that can contribute to removing barriers to energy savings performance-contracting project implementation. Partners to date include the National Association of Energy Service Companies (NAESCO), the National Conference of State Legislatures (NCSL), the National Association of Regulatory Utility Commissioners (NARUC), the National Association of State Energy Officials (NASEO), and the U.S. Conference of Mayors (USCM). The program's action plan has four simple objectives:

- To increase awareness of energy performance contracting among owners of buildings in the nonfederal sectors of the economy, including state government organizations, local government organizations, private companies, and other nongovernment organizations;

- To work with customers, ESCOs and other organizations to identify and remove barriers to increased delivery of energy efficiency, new high-efficiency technologies, and renewable energy by ESCOs;

- To offer easily accessed information about the energy performance contracting industry;

- To increase sales through ESCOs of high-efficiency and renewable energy products.

Services Provided by the DOE Energy Fitness Program

- Case studies of actual comprehensive energy efficiency projects to show how effective they can be.

  A description of the ESCO Industry through project case studies.

- Information for customers on how they can use ESCOs to increase efficiency and upgrade facilities.

  A customer handbook to guide procurement of ESCO services, including standard agreement language, standard project development procedures, sample solicitation and more.

- Information that makes it easy for consumers to select a pool of well-qualified ESCOs to bid on their projects.

  The Energy Fitness Program / NAESCO ESCO Accreditation Program provides a regularly updated list of accredited ESCOs and a description of the Energy Fitness / NAESCO Accreditation Program is available.

- Information about the size of the ESCO Industry, how much energy efficiency it delivers, and how much it reduces environmental emissions.

  Specifications and mechanisms to help the ESCO industry to gather hard data about its rate of project investment and financial, energy and environmental performance have been developed.

  This data is now being gathered.

- Support for the development and implementation of state ESCO enabling legislation to make the opportunity to use performance contracts to acquire energy efficiency improvements and facility upgrades available to state and local government organizations in all states.

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A review of the issues that need to be addressed and a composite of performance contracting enabling legislation from various states.

Model state legislation for removing legal and administrative barriers to ESCO delivery of energy efficiency to state, county and municipal buildings is being prepared.

- Information on the benefits of increased delivery of energy efficiency.

  A case study of the state-level jobs and economic activity benefits of increased delivery of energy efficiency.

- Support for the introduction of new high-efficiency technologies into the marketplace through the ESCO channel.

  Case studies of an ESCO's installation of 4003 geothermal heat pumps at Fort Polk, LA.

- Training on using performance contracting and ESCO services.

  Training is being provided for state and local government organizations, schools, hospitals and other organizations. Training is customized to fit the particular needs of each group trained.

- Information for college students considering careers in the ESCO industry.

  A report on the training students need to enter the ESCO industry and information on co-op training opportunities. Students take note: the ESCO industry, which includes both ESCOs and customers purchasing ESCO services, is a rapidly growing industry.

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The La Canada School District
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Headquarters, Forrestal Building
Viron Energy Services
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Johnson Controls, Inc.
The Hunts Point Cooperative Market
The Hyatt Regency Buffalo
Libbey-Owens-Ford
NORESCO
Onsite Energy
Ottawa University
Power System Solutions
Public Service Conservation Corporation
The Rhode Island Office of Energy Conservation
The San Jose Community Towers
St. John Medical Center
Southgate Community School District

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With all of these excellent contributions, this nonetheless remains my work, and I assume full responsibility for its content. No statement of fact or opinion in the text necessarily represents the position of the U.S. Department of Energy, Oak Ridge National Laboratory, NAESCO or of any of its members.

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THE ENERGY SERVICES INDUSTRY

Since energy is an essential element of every production cycle, its continued overuse by American companies relative to those in other countries can only contribute to America's competitiveness problems and make U.S. businesses more vulnerable to fluctuations in the price of energy.

A best case scenario...projects that the United States could save about 70 percent of the electricity it uses.

If improving energy efficiency is more economical than building new power plants, why isn't everyone installing such equipment? Many are.[1]

INTRODUCTION

Across the United States today, a quiet revolution is taking place in the creation and application of energy resources. New energy production capacity is being developed through the more efficient end-use of existing power production. Increasingly efficient manufacturing processes are yielding higher-quality and more cost-effective products through the use of technologies that reduce energy use. The by-products of energy-consuming processes are being converted from air-polluting emissions to fuels that can drive the very processes through which they are produced.

This growing demand for more efficient energy applications is driven by very practical considerations. As budgets are being slashed at all levels in the public sector—from federal appropriations to state and local funds—public agencies are being forced to seek the most efficient and economical means of providing their mandated services. Similarly, stiff competition from global markets is forcing the private sector to reduce operating costs to the most efficient possible levels. The availability of new, more energy-efficient technologies—from high-efficiency lights to energy-efficient motors and variable-speed drives—is creating the opportunity for all sectors of our economy to rethink the way energy is used in buildings and in industrial and manufacturing processes.

[1] Joseph J. Romm, *The Once and Future Super-Power: How to Restore America's Economic, Energy, and Environmental Security*, William Morrow and Company, Inc., New York, 1992.

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Decision makers at all levels of government are finding that lower operating costs resulting from the installation of more efficient energy-consuming equipment in public buildings translate immediately and directly into tax savings. In the private sector, companies are finding that energy-efficiency retrofits translate directly into increased profits through reduced operating costs. These savings are being applied in a number of ways. As demonstrated in these case studies, companies that might otherwise be forced to eliminate jobs or to relocate in order to remain competitive are able to retain their work force and to provide greater job security for their employees. More efficient manufacturing processes provide the capability for manufacturers to increase the quality of their products without increasing the cost to their customers.

Both the economic and the environmental benefits of these changes as they sweep through our economy are enormous. Within the U.S. economy, residential and commercial buildings alone consume one-third of all primary energy and 65 percent of all of the electricity we produce. By investing in energy efficiency, we can avoid more than 25 percent of this energy consumption. If the energy production capacity that is available to be saved in the residential and commercial sectors were to be provided from the construction of new electric power plants, it would require eighty (80) 1,000-megawatt plants with their attendant environmental impacts and siting concerns[2]. However, energy-efficiency investments in these sectors will enable us to avoid the cost of building those power plants and to free up existing energy supplies for other purposes while creating 345,000 new jobs and reducing carbon emissions by 72 metric tons annually. Public-sector and industrial investments in energy efficiency would make these impacts even larger.

A recent macroeconomic study demonstrates that by meeting a 2010 energy-use reduction target of 30 percent, the U.S. will reduce annual electricity generation by 27 percent and decrease the need for the construction of new generating facilities by more than 50 percent. U.S. electricity customers will enjoy an 18 percent overall reduction in their electricity bill (a savings of $50 billion), while electric sector emissions of carbon dioxide and oxides of nitrogen will be reduced by 33 percent and 12 percent, respectively. These lower costs for energy, available through private energy-efficiency investments, will enable U.S. consumers to increase their annual consumption of non-electricity goods and services by $45 billion.[3]

The catalyst for this revolution in how we think about and use our energy resources is a small but growing group of companies that are at the heart of an American-based growth industry in energy-efficiency services and technology, known as the **Energy Services Industry**. In these case studies, we provide an overview of this industry's work, including the types of technologies and project designs typically utilized by industry participants. The intent behind these case studies is to illustrate the energy-efficiency applications—from the typical to the cutting edge—available today. The projects represent a cross section of the end-use customers who are transforming their patterns of energy use as they increasingly

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[2] "DSM and the Broader Economy", Edward Moscovitch, *The Electricity Journal*, May 1994

[3] U.S. Department of Energy budget documents for fiscal year 1995

come to perceive energy costs not as fixed, but as a variable budget item often containing hidden revenues.

The reader expecting to find the 1970s "turn down the thermostat" 1970's energy conservation approach to reducing energy costs will not find it in these case studies. Today's Energy Services Industry has gone beyond the challenge of merely reducing consumption. Today the focus of the industry is on maintaining or even improving indoor comfort levels with technologies and project designs that are making it possible to use less fuel in the process. At the same time, this industry is offering commercial and industrial sectors opportunities for reduced energy consumption and costs that actually produce increases in production capacities as well as increased service capabilities where service is a marketable commodity.

It was possible, in these case studies, to highlight only a small fraction of the thousands of energy-efficiency projects being undertaken across the country today. However, the selection of the case studies is intended to give the reader an overview of the types of technologies, the types of projects, and the types of project designs being applied throughout the Energy Services Industry. The applications reviewed in the case studies range from a standard comprehensive energy efficiency retrofit of a public school district, to the energy-efficient redesign of a major industrial process, to the use of energy-efficient technologies to address an indoor air quality problem, to the blending of cogeneration technologies and waste-to-energy concepts with an energy-efficiency format. All of these projects involve some form of ***measurement and verification*** of energy savings and/or a ***performance guarantee*** on the part of the energy services company designed to ensure that the customer in fact receives the intended level of energy savings.

An important new growth area in energy-efficiency investments is the export of this American technology and expertise to private- and public-sector facilities around the globe. Facility owners, utilities, and government officials throughout the world are expressing a growing interest in the American Energy Services Industry, and a number of American companies now offer energy efficiency products and services internationally. These off-shore projects create export opportunities for American equipment manufacturers and investment opportunities for American capital.

A final introductory note on these case studies: while most energy efficiency projects share a number of common components, the case studies are written to highlight only one or two of those components in each project. In this way, the document as a whole provides a discussion and examples of all major aspects of an energy-efficiency project while sparing the reader an excess of repetition. In order to orient readers who may be less familiar with this industry, a brief overview of the industry, its history, and the technologies and services it offers is provided in this introduction.

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INTRODUCTION

Introduction to the Energy Services Industry

The term **Energy Service Company**, or **ESCO**, is used to refer to a member of the Energy Services Industry—i.e., an ESCO is a company engaged in developing, installing, and financing comprehensive, performance-based projects, typically 7 to 10 years in duration, centered on improving the energy efficiency and maintenance costs for facilities owned or operated by customers.[4]

ESCOs typically are small- to medium-sized entrepreneurial companies that act as project developers responsible for an unusually wide spectrum of tasks: they develop, design, and finance energy-efficiency projects; install and maintain the energy-efficient equipment involved; measure, monitor, and verify the project's energy savings; and assume the risk that the project will save the amount of energy promised. All (or most) of these activities are bundled into a project's cost, which is usually financed through a third party identified by the ESCO.

While many ESCOs are independent firms, some are affiliated with utilities or with manufacturers of controls or heating and cooling equipment. In addition to the economic benefits conferred upon their customers through energy and maintenance cost savings, energy service companies create new jobs, not only within their companies, but through the use of contractors and equipment suppliers and other firms involved, directly and indirectly, in supporting energy-efficiency projects. For example, the ESCO industry has spawned a new group of firms that specialize in providing the hardware, software, and services required to measure energy savings. Approximately one-third of the money invested in ESCO projects is applied to labor costs. In addition, the energy-efficiency technologies installed by ESCOs are primarily U.S.-produced, providing an added stimulus to the U.S. economy. Energy service companies thus support American manufacturing and stimulate job growth while enhancing the competitiveness of U.S. industry by reducing the operating costs of the nation's buildings, and manufacturing facilities and processes.

While ESCOs have built an impressive, steadily growing industry in the United States, they rarely are understood as the unique brand of project developer that they are. Some observers confuse ESCOs with energy-efficiency consulting firms and some with equipment contractors, both of which, unlike project developers, accept no project risk. ESCOs currently are less well known than the better-financed independent power developers. However, as these case studies demonstrate, in order to maximize their customers' energy savings, some ESCOs are beginning to design projects that combine energy efficiency measures with technologies, such as cogeneration, typical of the independent power industry.

Energy efficiency projects are considered *performance-based* when the ESCO's compensation, and often the project's financing, are meaningfully tied to the amount of

[4] ESCOs typically refer to the party in whose facilities they install energy conservation measures as a *customer* or *client*.

energy and maintenance costs actually saved.[5] This performance requirement distinguishes ESCOs from consulting engineers specializing in efficiency improvements. The latter typically are paid a fee for their advice and undertake no risk that their recommendations will yield results. Projects are *comprehensive* when the ESCO seeks to achieve energy savings from the widest possible array of cost-effective measures in a given facility. ESCOs are therefore also distinguished from specialized purveyors of single-measure installations (usually lighting contractors) who typically offer no performance guarantees and usually disregard the potential for savings unrelated to the equipment in which they specialize.

While comprehensive energy-efficiency retrofits offer the opportunity for substantial reductions in operating costs, they tend to require a large initial capital investment. Depending on the type and range of equipment required, there may be a relatively long payback period. Thus, many potential customers, particularly in the public sector, are reluctant to embark on these projects since they lack the internal funding to do so. However, as will be seen repeatedly throughout these case studies, the Energy Services Industry has addressed this issue by including project financing among the services offered to customers. A customer's debt payments, moreover, are tied to the energy and other savings offered under the project, so that in many cases, the customer pays for the capital improvement with dollars that come only out of the differential between pre-installation and post-installation energy and other costs, as *measured and verified*.

Customer choice is one of the hallmarks of the Energy Services Industry. Customers choose the scope of performance to be guaranteed, which determines the appropriate measurement and verification (M&V) metric, based on their own individual circumstances and needs. Customers retaining effective facility management organizations and having their maintenance and facility management costs under control may prefer projects that only address the energy efficiency of their facilities. For these customers, M&V of energy savings may be a good metric for determining project performance. Customers focusing on their core businesses may prefer a more comprehensive performance guarantee for the total cost of facility operation, including the energy-efficiency project installation, and also the costs of equipment maintenance and facility management. For these customers the M&V may need to capture the total dollar savings of all of the benefits the customer wants guaranteed. Whatever the customer chooses, it is the ESCO's ability to deliver dollar savings that makes ESCOs so useful to customers.

Of no less importance than the reduction in energy consumption—which is the direct purpose of most energy-efficiency projects—is the attendant reduction in air emissions from electric power generation and fossil fuel consumption in customer facilities. As one of the case studies demonstrates, the sophisticated *measurement and verification* technologies available through the Energy Services Industry are now being used to translate reductions in energy consumption into measurable reductions in air pollutant emissions. In areas where air quality is a concern, the ability to measure reductions in air emissions can create opportunities for attracting new business into an area without exceeding permissible air emission levels.

[5] *Performance contracting* is another term for the performance-based approach.

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As will be seen in the following case studies, ESCO projects typically aim to increase the efficiency of end-uses consuming electricity and thermal energy sources (largely natural gas, fuel oil, and steam). Measure for measure, projects have tended to involve more electrical end-uses because electricity is a more expensive form of energy; thus, the dollar savings are greater. However, comprehensive ESCO projects often involve thermal measures as well. Moreover, the trend is toward greater comprehensiveness in this sense, as ESCOs move increasingly to serve industrial customer markets to supplement the commercial and institutional markets in which they have long been active. Though not covered in this report, there also has been a recent trend toward extending ESCO-style performance contracting to water conservation.

History of the Energy Services Industry

ESCOs in the United States have been developing performance-based energy efficiency projects for the better part of fifteen years. Most U.S. ESCOs place the industry's origins in the late 1970s and early 1980s. Its impetus was the dramatic rise in energy prices following the 1973 Arab oil embargo and the Iranian Revolution in 1979, which presented the opportunity to make a business out of reducing customers' growing energy costs.

A few of the ESCOs entering the marketplace in the early 1980s, and since, have been start-up entrepreneurial companies established specifically to pursue energy performance contracting. A number of ESCOs grew out of businesses providing engineering services for a fee that opted to move from consulting to project development, backing their designs with performance guarantees and securing financing for projects with the savings these projects were guaranteed to produce. A few ESCOs are affiliated with manufacturers of building controls systems designed to regulate energy-using equipment in buildings and factories, or with manufacturers of heating and cooling equipment. The final major category of ESCOs includes those formed in response to the growth of utility demand-side management programs, either by the utilities themselves or by private investors.

Whatever their origins, all ESCOs are characterized by their project development capabilities and their assumption of performance risk for their projects.

Technologies and Services Employed in Performance-Based Energy-Efficiency Projects

A number of technologies have come to form the core of the typical performance-based energy-efficiency project. These include high-efficiency lighting, of both the fluorescent and incandescent type; high-efficiency heating and air-conditioning equipment; efficient motors and variable speed drives; and centralized energy management systems. Along with the core technologies come a full array of weatherization services where appropriate. Depending upon the characteristics of a particular project, these core technologies may fully exhaust the energy savings available for that project, or they may form the basis upon which other innovative efficiency applications, such as integrated cogeneration or renewable energy technologies, are added. Similarly, an older facility may benefit from a renovation of its

steam heating system or from a new on-site power plant. Work such as this can be accomplished within the context of a comprehensive performance-based energy efficiency project, and the long payback period on such an investment can be offset by the substantially shorter payback on many of the core energy-efficiency technologies.

Because ESCO projects are performance-based, ESCOs must ***measure*** the energy and other types of savings, and these savings must be ***monitored*** over the project's life in order for the term ***performance-based*** to have meaning. Measurement essentially means ongoing verification of energy and other savings, often by periodically comparing a customer's energy bills and maintenance and facility management costs against established pre-project baselines. Energy savings measurement, as defined here, is a general category of which the newer practice of ***metering***—direct tracking of energy savings according to sanctioned engineering protocols—is the most accurate type. The purpose of monitoring measured energy savings over time is to ensure that those savings persist and to identify immediately any anomalies in consumption patterns that may occur. It also serves to ensure the quality and effectiveness of ongoing maintenance, entailed in most ESCO projects.

ESCOs have always led the effort to verify, rather than estimate, energy savings, particularly where public and utility ratepayer funds are paying for them. The exigencies of performance contracting compel ESCOs to measure and monitor the energy that they save. Several years ago, the ESCO's effort to standardize the measurement of savings gained powerful momentum when U.S. electric utilities turned to private providers for firm ***demand-side*** capacity. With utilities under regulatory pressure to invest in efficiency programs with strictly verifiable results, protocols and equipment to measure energy savings cost-effectively have flourished.

One of the landmark protocols arose under the auspices of utility regulators in New Jersey, who, along with the state's largest utilities and many leading ESCOs, prepared and adopted a comprehensive set of engineering protocols using meters to directly measure the use of installed energy-efficiency measures and thus to provide a real-time basis for calculating actual energy savings. A revised version of the New Jersey protocol was developed next in California.

Most recently, a working group consisting of representatives from the U.S. Department of Energy and representatives of NAESCO, the National Association of State Energy Offices (NASEO), and the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE), as well as industry and academic experts and specialists, cooperated to develop the National Energy Monitoring and Verification Protocol (NEMVP). The Federal Energy Management Program Office in the U.S. Department of Energy has created an application of the NEMVP to fit federal projects. In addition, the ASHRAE working group specializing in measurement issues (ASHRAE GPC 14P) is engaged in the development of a comprehensive set of measurement and verification guidelines, "Measurement of Energy and Demand Savings," which is expected to further strengthen the technical foundation of the NEMVP.

ENERGY FITNESS
INTRODUCTION

By combining technical accuracy with cost-effectiveness, these protocols mark a notable improvement over previous practices. They largely render the far less accurate (and often expensive) practices of utility impact evaluation and engineering estimates effectively obsolete for most conservation measures in nonresidential buildings. Today, the use of these protocols is considered by many to be a crucial component of any comprehensive energy-efficiency retrofit. It is important to note, however, that each of these protocols, as well as the forthcoming ASHRAE Guideline, is designed to provide a format for the measurement of energy and demand savings only. For projects where maintenance and facility management cost savings are part of the performance that the customer wants guaranteed, these cost savings must be calculated separately and added to the energy cost savings. In general, however, the calculation of maintenance and facility management cost savings is a fairly straightforward matter because customers generally know what they have been spending in the past, and ESCOs have generally provided these services to other customers with similar facilities and know what these services should cost.

The baseline against which reduced energy use is measured must be established for each performance-based energy-efficiency project. For most projects, an initial energy audit is conducted to gain a general inventory of energy-consuming equipment. It may also provide some approximations as to run times and other use. This general information can help to determine the potential scope of an energy-efficiency project, and often forms the basis on which an ESCO and a customer agree to take the next step in the development of a project—the conduct of the more comprehensive investment-grade energy audit. Unlike the initial audit, the investment-grade energy audit must be used as the basis for financing the project, as well as the basis for projecting energy and other savings on a performance contract. Therefore, it is imperative that this audit be as detailed and reliable as possible. Because of their importance, ESCOs almost always perform their own investment-grade energy audits, or have them performed by an engineering subcontractor hired to provide the technical design for the project. Rarely, if ever, will an ESCO enter into an energy-savings performance contract based on an energy audit conducted by an independent third party.

Included within the ancillary services found in a typical performance-based energy-efficiency contract are the removal and disposal of hazardous materials from a customer's facility. For example, existing fluorescent lighting equipment uses ballasts containing PCBs and fluorescent light tubes containing traces of mercury. Therefore, when existing lighting equipment is removed and replaced with new high-efficiency lighting, the old equipment must be disposed of as hazardous waste. Similarly, upgrades to heating, air-conditioning and ventilation systems may involve the removal of asbestos. An energy services company typically will arrange for the removal, transportation, and disposal of all hazardous material as an integral part of an energy-efficiency project.

Two other critical components of every energy-efficiency project are the education of the customer to that customer's own energy use patterns and the development of an energy-efficiency partnership between the ESCO and the customer. Since energy-efficiency retrofits combine efficient technologies with an analysis of energy use patterns, the customer must understand how its energy use is related to the business it conducts. The customer also

must have an interest in maintaining the use patterns that form the basis of the energy-efficiency analysis, or must be willing to work with the ESCO to reassess use if patterns change. Reduced to its bare essentials and using the simplest possible form of measurement and verification, an energy savings performance guarantee is based on a straightforward calculation of Watt or BTU-per-hour reduction multiplied by hours of use for a particular piece of equipment—whether it is a light fixture or a motor. If, during the course of the contract period, the customer decides to shut down that piece of equipment or to dedicate it to a different use, the assumptions that form the basis for the energy-savings calculation no longer hold. Therefore, each ESCO entering into an energy-savings performance contract endeavors to educate its customer on energy use and seeks to bring that customer into an energy-efficiency partnership whose purpose is to achieve the maximum energy savings available from the customer's facility.

The final component of most performance-based energy-efficiency projects is the maintenance of the new high-efficiency equipment. It is standard practice in the industry for a performance contract to include maintenance by the ESCO of all or some portion of the new equipment over the life of the contract. The cost of this ongoing maintenance is folded into the overall cost of the project. Thus, throughout the life of the performance contract, the customer not only receives the benefit of reduced energy costs, but also of reduced maintenance costs. The maintenance component also is important since it enables the ESCO to ensure that the equipment is maintained in a way that preserves optimal performance. As an additional service on most contracts, the ESCO also provides any specialized training needed so that the customer's maintenance staff is equipped to take over at the end of the performance contract period.

CASE STUDIES

REDUCING AMERICAN'S TAX BURDEN WITH ENERGY EFFICIENT RENOVATIONS OF PUBLIC BUILDINGS

The infrastructure of our economy lies in our factories, commercial buildings, public and private office buildings, warehouses and numerous other physical plants throughout the country, in addition to the roads and communications systems that link them. The majority of this building stock predates the advances in energy efficiency technologies of recent years. In the public sector, from the local to the federal level, shrinking budgets and growing concerns over the fiscal and environmental costs associated with energy production have created a strong demand for the energy efficiency renovation of our public infrastructure.

Optimizing the Use of Local Tax Revenues by Making America's Schools Energy Efficient

Perhaps the most widespread example of this national trend toward upgrading the existing public infrastructure is the large-scale renovation of our public school systems by members of the ESCO industry using energy savings performance contracts. School districts, which tend to be heavy energy users, realize numerous public benefits when their facilities

are renovated. Utilities and their ratepayers benefit from the reduced energy demand, which can keep rates down throughout the entire service territory and avoid the need for new power generation facilities. The local school board is able to free up funds, formerly allocated to overhead, to directly fund programs and needs central to the mission of educating America's youth. And the students themselves enjoy a more comfortable facility with improved heating and air conditioning as well as higher-quality lighting.

Projects such as the two analyzed in the following case studies represent so widespread an application of energy efficiency technologies by the ESCO industry that they have become the core business, or bread and butter, of many companies in the industry.

Case Study 1: The Desert Sands Unified School District (Onsite Energy)[6]

The Desert Sands Unified School District (DSUSD) in Indio, California, is a large district, spread over a broad radius of approximately 30 miles. It also is in a period of extremely rapid growth, adding approximately one school per year. Upon learning about energy efficiency services in 1988 through an initial contact by an ESCO, DSUSD Administrators recognized these services as a means of reducing their operating costs, while improving operations and maintenance services to their schools.

DSUSD issued a request for proposals (RFP) from all interested energy service companies to design and bid on an energy efficiency retrofit for the School District. Three companies responded to the RFP. Onsite Energy was selected for the job and negotiated a two-stage contract with DSUSD. In Phase 1 of the project, completed in April 1991, Onsite provided DSUSD with $1.4 million in capital improvements to retrofit one administration building and 20 school buildings, consisting primarily of portable units and single story wood and stucco buildings, including classrooms, gymnasia and multipurpose rooms. Approximately 40 percent of these classrooms are housed in portable structures. The buildings covered in this Phase range from 10 to 25 years in age, with a total of approximately 922,000 square feet.

Under the terms of its energy services agreement with the School District, Onsite conducted an energy audit of the DSUSD buildings, including an energy bill analysis, a lighting and mechanical inventory and interviews with school maintenance personnel and faculty to determine occupancy and usage. Based on the results of this audit, Onsite estimated that DSUSD was consuming approximately 48,456 kW of electricity (10,670,203 kWh) and 90,173 therms of natural gas each year to heat and cool these buildings.

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[6] Desert Sands Unified School District, 82-879 Highway 111, Indio, California 92201; Onsite Energy, 701 Palomer Airport Road, Suite 200, Carlsbad, California 92009.

As with many energy efficiency projects, one of Onsite's key functions here was to identify financing for the project. Onsite arranged for third-party financing for the $1.4 million to finance Phase 1 of the project and ultimately purchased the loan, providing its own financing for the remainder of the project. This has enabled Onsite to provide additional energy retrofit equipment and thus additional savings to DSUSD during Phase 2 of the project.

The Phase 1 retrofits were focused on lighting; heating, ventilating and air conditioning (HVAC); and energy management. T10 fluorescent tubes with electronic ballasts and specular reflectors were used to reduce electricity consumption and improve lighting quality in all areas. Approximately 50 percent of the HVAC units at the DSUSD are air source heat pumps in the three to five ton range. Onsite installed a NOVAR Logic One DDC energy management system, providing centralized control of all heat pump units. Onsite also installed optimum start software to bring occupied spaces to set temperatures before scheduled occupancy while avoiding the demand spikes that previously occurred. The energy management equipment also includes an outside air reset, which allows the indoor cooling setpoints to fluctuate up or down depending upon outside air temperature. For example, when the outside temperature is 80° F or below, inside temperatures are set for 74° F. As the temperature outside increases to 100° F, the inside setpoint is gradually allowed to drift up to 76° F.

With this comprehensive approach, and its tailoring of state-of-the-art technologies to DSUSD's physical plant and operations, Onsite was able to guarantee the School District energy cost savings of $326,410 per year for ten years from the date of project completion. This will result in a projected total savings of approximately $3.3 million for Phase 1. Based on monitored energy usage and verified savings, the School District's energy cost savings actually have exceeded the guaranteed amount in each year since the completion of Phase 1. Construction for Phase 2 of the project is in progress.

"Most important to our school administration personnel," says Carol Miller, the School District's Business Manager, "the NOVAR energy management system allows central computerized control of all of the School District's HVAC units, which have increased by approximately 1,000 since the system was installed. With this system, the maintenance staff can respond immediately to technical problems, usually without the need for a service call. Our system's efficiency has improved dramatically simply by our ability to now have all units automatically shut off at night and brought back up in the morning. At the same time, individualized needs, like the need to maintain temperatures over a weekend for a classroom pet, can be met through the computerized system."

The combined benefits of energy cost reductions and centralized control of the HVAC units have allowed DSUSD to contain costs while expanding to meet the educational needs of its rapidly growing population. According to Carol Miller, "Our new computerized energy management system has allowed DSUSD to grow without the need to add maintenance personnel. We now require the NOVAR energy management system in all of the District's new schools, and we definitely recommend this type of centralized energy management system for all school districts across the country."

The School District also has realized other benefits from its experience on this project and the relationship it has developed with Onsite. Onsite has provided training for all maintenance personnel on the equipment installed and provides ongoing backup for District personnel on all energy and efficiency related matters. Says Carol Miller, "School administrators are always generalists. We don't have the specialized expertise to fully analyze our options for energy savings. Working with Onsite has given us in the District administration a sense of security at having the ESCO's expertise available for the project as well as for follow-up. At the same time, it has enabled us to learn and to become more knowledgeable energy efficiency consumers. "Not only has DSUSD maintained its relationship with Onsite for ongoing backup, but it now looks to the ESCO Industry regularly for energy efficiency upgrades as it finds new ways to reduce costs and improve services in the School District."

The Desert Sands Unified School District in Southern California has successfully employed energy efficiency technologies to mitigate energy demands and costs associated with the space cooling needs of that climate. At the other end of the temperature spectrum, the Southgate Community School District, near Detroit is now relying on similar energy efficiency technologies to reduce its heating, lighting and other energy costs while maintaining the comfort level in its classrooms.

Case Study 2: Southgate Community School District (Energy Masters Corporation)[7]

Prior to embarking upon its energy efficiency retrofit during 1991 and 1992, the Administration of the Southgate Community School District (Southgate), in a suburb of Detroit, Michigan, had considered the potential benefits of an energy efficiency upgrade of its ten 30-year-old buildings. However, because of uncertainties, particularly with respect to the reliability of the payback of such a project, the Southgate Administration was reluctant to go forward with such a large investment. Therefore, in 1990, when Energy Masters Corporation (EMC) approached Southgate through the Detroit Edison demand-side

[7] Southgate Community School District, 13100 Burns, Southgate, Michigan 48195; Energy Masters Corporation, 9101 West 110th Street, Suite 200, Overland Park, Kansas 66210.

management program, and offered an energy efficiency retrofit with a payback guarantee backed by the company and approved by Detroit Edison, Southgate was ready to agree.

In this project, EMC implemented a comprehensive array of upgrades in the ten Southgate facilities, which encompass 643,000 square feet. The project design included a high-efficiency lighting retrofit, insulation and weatherization, lowering some ceilings, temperature controls, swimming pool covers, radiator valves, steam trap replacements, and the installation of a centralized energy management system.

Under Michigan law, a public entity can borrow money for the purpose of undertaking energy efficiency upgrades—i.e., issue energy efficiency notes—without the need for a public referendum. Using this approach, Southgate was able to finance the $1.3 million project through a third-party tax-exempt municipal lease with debt service of $162,732 per year for ten years. Southgate also received demand side management rebate payments from Detroit Edison totaling $21,500 and from Michigan Consolidated Gas Company totaling $37,050.

After designing and implementing the project on a turnkey basis, EMC guaranteed Southgate an annual energy cost savings of $174,732 for ten years, based on EMC's measurement and verification of the reduced energy usage.[8] If Southgate does not realize that level of savings in any year during the ten-year payback period, EMC will pay the difference. In turn, 20 percent of any excess savings is paid to EMC as a performance incentive; 80 percent of the excess savings stays with the District for its own discretionary use. Thus, Southgate is funding the improvements entirely from its operating budget by diverting some of the energy savings—money that otherwise would have been paid to the gas and electric utilities for wasted energy—to pay instead for the physical plant improvements.

In order to establish the guaranteed level of savings for the project, EMC calculated the savings from all energy conservation measures on an interactive basis using computer modeling. Some long-payback measures such as lowering the ceilings were subsidized by short-payback measures to produce the ten-year net payback term.

During the first 31 months of the program (December 1994 through June 1995), verified savings totaled $681,112, versus costs of $420,391 (debt service and $31,000 for EMC monitoring and savings verification). Of the $229,721

[8] The $174,732 guarantee covers Southgate's debt service of $162,732 plus $12,000 per year to cover EMC's cost for measuring and verifying the energy savings.

excess savings, the District's 80 percent share has amounted to $183,777, an average of nearly $6,000 a month savings, in addition to enjoying the benefits of the improvements.

Like the Desert Sands Unified School District, Southgate is reaping the rewards of the centralized energy management system. At Desert Sands the temperature question is one of keeping facilities cooled on an as-needed basis. In Southgate, heating is the issue, but the outcome is the same. At certain times of the winter, when comfort becomes an issue in a few of the southeast-facing classrooms, the energy management system allows maintenance staff remote access through the central computer to override preset controls and increase the temperatures in those rooms during use, without a service call.

An added benefit, according to Southgate Business Manager, Rick Heneger, is the fact that the energy management system enables the maintenance staff to spot potential problems and address them on a scheduled basis before they become critical. Again, emergency service calls are reduced, and there are fewer disruptions to the school district's normal operations.

When questioned about his impressions of working with an ESCO, Rick Heneger noted that his maintenance staff is fairly sophisticated in their knowledge of energy efficiency measures, and probably could have implemented most of the standard measures used at Southgate themselves. He also pointed out that financing the project was not a problem for Southgate, given the school district's ability to issue energy efficiency notes under Michigan law.

"For Southgate," he said, "the real problem was taking that crucial step from concept to implementation. This is a big investment and we were concerned about the payback. We just weren't comfortable going to the School Board to ask for that kind of money without some assurance of the payback. But once EMC showed us their savings guarantee, we went for the project without a second's hesitation. Even when you know about energy efficiency technologies, like a lot of us here in Michigan do, and even if you can pay for the project yourself, sometimes you need the ESCO to step in and provide the catalyst and the verification that the savings really will be there."

Multiplying Tax Savings by Financing Energy Efficiency Retrofits Out of Energy Savings

The substantial cost of the capital investment required to accomplish a comprehensive energy efficiency retrofit is especially problematic in the public sector. Crucial to these projects is the ESCO's ability to bring financing to the table and to apply the savings generated to cover the cost of all capital investments, as well as maintenance of the equipment and measurement and verification of savings. In order to further enhance the value of these projects to their customers, particularly those in the public sector, ESCOs have developed a

financing arrangement that combines a guarantee of savings to its customers along with an incentive to the ESCO itself to tap all possible savings available in the project. The following case studies provide an example of this guaranteed savings/shared savings hybrid payback arrangement that has become popular in the ESCO industry in recent years.

Case Study 3: La Canada School District (Energy Masters Corporation)[9]

In 1991, when the La Canada School District, serving a suburb of Los Angeles, undertook negotiations with Energy Masters Corporation (EMC) to upgrade the School District's energy use, one of its goals was the creation of an incentive to motivate the ESCO to maximize all possible energy savings. EMC met this objective with a combined energy savings guarantee and incentive payment if excess savings were achieved. This hybrid arrangement, which has become popular in the industry, provides the dual benefit of certainty for the customer with respect to a minimal level of savings, and a motivator for the ESCO to provide the most comprehensive energy retrofit available.

EMC offered La Canada a comprehensive energy efficiency retrofit designed to meet the needs of its facilities, engineered and installed on a full-responsibility turnkey basis. The performance of the project is backed by a savings guarantee wherein the District is assured that savings are adequate to cover all costs until the project is fully paid for in seven years. If measured and verified energy savings in any year are inadequate to cover all costs (debt service plus EMC annual fee for maintenance and monitoring), EMC would reimburse all shortfalls to the District. In turn, 20 percent of any excess savings are paid to EMC as a performance incentive; 80 percent of the excess savings stay with the District for its own discretionary use.

Under this program, EMC implemented a comprehensive assortment of pay-for-themselves energy-efficient retrofits in the District's largest school, La Canada High, which comprises 285,000 square feet. The installation was performed in three phases so as to satisfy special federal grant requirements. Phase 1 was completed in December 1991, with the ensuing two phases completed in 1992 and 1993.

These improvements included the redesign and recommissioning of a nonfunctioning 120-kW cogeneration system, installation of a wide array of energy-efficient lighting retrofits, installation of a computer-based energy management control system, conversion of multizone constant-volume air handling systems to variable air volume, and various modifications to temperature controls.

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[9] La Canada School District, 5039 Palm Drive, La Canada, California 91011; Energy Masters Corporation, 9101 West 110th Street, Suite 200, Overland Park, Kansas 66210.

The District did not provide any up-front funds for the project. Rather, Energy Masters arranged a $480,000 integrated funding package consisting of utility rebates, federal energy conservation grants, and a third-party tax-exempt seven-year municipal lease. The lease contains nonappropriations language such that the bonded indebtedness of the District is not affected. The District is thus funding these facility improvements entirely from its energy operating budget by diverting energy savings to pay instead for the improvements.

During the first three and a half years (42 months) of the program, January 1992 through June 1995, verified energy savings have totaled $365,845, while the District's total cost for debt service and energy savings monitoring and verification for the project came to only $249,514. Of the $116,331 excess savings, the District's 80 percent share from this one school, has amounted to $93,065, or an average of $2,215 per month.

Case Study 4: Parma City Public Schools (Landis & Gyr Powers)[10]

The Parma City Public School District in the Cleveland suburbs includes 24 buildings encompassing more than 2 million square feet of space. Through an energy services contract with Landis & Gyr Powers, the School District was able to undertake a long-term energy efficiency program in response to Ohio's House Bill #264, which allows public schools to borrow funds for implementing energy conservation measures, provided they net a 100 percent payback within 10 years. As part of this program, the School Board also wanted to take advantage of the Department of Energy's Institutional Conservation Program (ICP), where available federal funds can match up to 50 percent of certain costs of energy conservation.

Landis & Gyr initiated the project with a district-wide evaluation of all facilities, providing the basis for a long-term, all-inclusive energy conservation program. The installed project includes a direct-digital-control energy management system; a major lighting retrofit, including ballasts, lamps, and fixtures; installation of new boilers; an air-handler retrofit, and a unit ventilator update.

Among the added services provided by the ESCO were regular project progress reports to the School Board; assistance to the School District in obtaining utility rebates and other entitlements as a result of the energy usage reductions; the design of a Technical Support Program tailored to the school engineering staff's needs, including a blend of on-site training, full-service coverage of the automation and pneumatic systems, all software updates and ongoing consultation concerning other energy conservation opportunities that would impact favorably on energy svings, comfort and health; and quarterly reports

[10] Parma City Public Schools, Parma City, Ohio; Landis & Gyr Powers, 1000 Deerfield Parkway, Buffalo Grove, IL 60089-4513.

to the School District's engineers and Board, detailing the current statistics relative to energy savings.

The total energy savings—of natural gas, electricity and oil—produced by the Parma City School District project is over $300,000 per year, exceeding the program's initial projection. In addition, indoor comfort of students and faculty has increased noticeably, and calls to adjust temperatures at numerous locations throughout the School District have fallen sharply.

Saving Federal Tax Dollars by Using Energy Efficiency Retrofits to Reduce the Cost of Operating Federal Buildings

The Federal Government is the largest consumer of energy in the United States, with a budget of over $4 billion per year to light, heat and cool the buildings it owns and operates. By turning to the Energy Services Industry to finance, design, install and maintain energy efficiency retrofits in federally owned and operated buildings, the United States can reduce the federal budget by an estimated $1 billion each year when compared with its current costs for energy.

The U.S. Department of Energy (DOE), through its Federal Energy Management Program, is under congressional mandate to facilitate private energy efficiency investments in federal facilities. To demonstrate the benefits of turning to the Energy Services Industry for the design, financing and installation of these projects, the DOE selected its headquarters building, the James Forrestal Building, for an energy efficiency retrofit. While this project, like many in the federal sector, suffered from extreme time delays due to an extensive procurement and contracting process that ultimately took three and one half years to complete, the actual installation was completed in a matter of months. Efforts are under way to address the problem of procurement and contracting delays in the federal sector.

Case Study 5: U.S. Department of Energy Headquarters, The James Forrestal Building (EUA Cogenex)[11]

The DOE Headquarters encompasses 1.63 million square feet of office space and corridors. After being selected through a public bid process to design an energy efficiency retrofit for the Forrestal Building, EUA Cogenex concluded that the design and use of the building required a focus on lighting and use of space. As a result, the project called for the installation of 32,777 specular reflectors, 13,984 low power electronic ballasts, 287 infrared occupancy sensors and 32,777 high-efficiency fluorescent lamps.

[11] United States Department of Energy, James Forrestal Building, 1000 Independence Avenue, S.W., Washington, D.C. 20585; EUA Cogenex, Boot Mills South, 100 Foot of John Street, Lowell, Massachusetts 01852.

The project, financed by EUA over seven years on a shared savings basis, is generating an estimated annual energy savings for the DOE of approximately $400,000, or approximately $2.8 million over the seven-year contract term. The Potomac Electric Company contributed $1,160,543 in utility rebates to help fund the project. EUA handled the application for these rebates on behalf of the DOE.

EUA was presented with a number of logistical issues in accomplishing the installation of this project. The most critical of these was related to the fact that the ceilings in the Forrestal Building contain asbestos. Prior to this project, the asbestos had been abated through an encapsulation project. To protect the DOE's investment in that work and, more importantly, to protect the work crews and the building occupants, EUA worked with the lighting product manufacturer to develop an alternative installation procedure which would accommodate the asbestos constraints.

Security clearances were required for all work crews. In addition, the project work had to be executed with minimal impact on the building's occupants. Consequently, the crews worked from 6:30 p.m. to 6:00 a.m., removing old fixtures and ballasts, rewiring and installing new equipment, and leaving the offices cleaner than they found them. A local, specialized recycling company was hired to properly dispose of the construction waste.

Not only is this project saving the DOE and federal tax payers a considerable amount of money in energy costs, but it has also resulted in a substantially improved work space for DOE employees. Over time, a considerable number of lighting fixtures in the building had stopped working or disappeared. As a result, prior to the installation of the energy efficiency retrofit by EUA, lighting quality in many areas of the building was extremely poor. EUA was able to provide superior lighting to all areas while at the same time guaranteeing the energy savings under the terms of its contract.

According to Jim Vajda of EUA, "We brought light levels up from about 30 footcandles at the desk level to federal standards of 50 footcandles, and the initial feedback was that it was too bright. But we gave people a couple of weeks to adjust, and talked about the energy savings, and now they like it. We get comments like 'I can see things in the Xerox room!'"

Preserving Federal and Community Jobs Through Energy Efficiency Retrofits

With public-sector downsizing, the need to reduce costs, increase competitiveness and preserve jobs is not limited to the private sector. When Hill Air Force Base, the largest employer in the state of Utah, was faced with possible closure, the Base Commander turned to a base-wide energy efficiency retrofit as one means of reducing the costs of operating and maintaining the Base. In addition to the thousands of jobs that this project helped to save in Utah, Hill Air Force Base combines a number of the aspects of energy efficiency project design that are proving to be important to public-sector facilities. In particular, the ability to pay for high-cost repairs and equipment upgrades out of energy savings is attractive to facility managers whose budgets may no longer include funds for capital repairs and improvements. Two other important sources of dollar savings are provided by energy efficiency projects. First, the ability to fold a long-term maintenance contract, provided for by the ESCO, into the total project cost. Second, the energy management systems typical of these projects, and noted throughout these case studies, can dramatically reduce maintenance time and costs at a facility, particularly large multiuse facilities such as military bases.

Case Study 6: Hill Air Force Base (CES/Way International)[12]

The Hill Air Force Base (Hill AFB) energy efficiency retrofit represents the first project in which the Federal Government has sought to upgrade the energy efficiency of an entire military base. Hill AFB is a 20-year, $19 million project covering a total of 1400 buildings which range up to 50 years in age and encompass 13,500,000 square feet.

When Hill AFB appeared on the potential hit list for base closings, the Base's Command undertook an aggressive program to increase the Base's competitive posture compared to other remanufacturing and repair service facilities in the region. With 15,000 employees, the Base not only is a significant component of the regional economy, it is the largest employer in the state of Utah and Utah Power & Light's second largest customer, making its continued operation vital to the economy of this area.

CES/Way, under contract to Utah Power & Light, undertook the Hill AFB project with a number of clear priorities. The Base, like all federal facilities, is under a Presidential mandate to reduce energy consumption by 30 percent by the year 2005. In addition to its critical need to reduce its energy use, without jeopardizing jobs or operations, the Base contained a substantial amount of old equipment in serious need of replacement. Among this aged equipment were many HVAC controls that had become entirely nonfunctional,

[12] Department of the Air Force, Hill Air Force Base, 7302 Wardleigh, Hill AFB, Utah 84056-5223; CES/Way International, Inc., 5308 Ashbrook, Houston, TX 77081.

causing outside air ventilation to be below minimum requirements. This, combined with inoperative zone temperature controls, contributed to temperature discomfort in numerous areas and the inability to provide suitable working conditions for the occupants.

The old and unreliable equipment required a substantial amount of maintenance time, including system downtime. The outdated chiller system was in need of replacement not only due to costly maintenance, but also because of the need to eliminate CFC refrigerants. As is typical of energy efficiency projects, the entire capital renovation had to be paid for out of energy savings and other project-related savings.

In this situation, CES/Way designed a shared energy savings project based on a federal energy savings performance contract (ESPC). The project involves a three-year buildout, with completion planned for 1997-98, and a 15-year performance period. The $19 million project is entirely financed through the ESCO, using third-party financing and Utah Power & Light demand-side management incentives.

Given the need to finance a broad range of capital equipment out of energy and other project-related savings, the project design combines energy conservation measures having a short payback period, including a 43,050-fixture lighting retrofit, with more costly measures, such as two new 150-ton chillers, three new pumps and two new 150-ton cooling towers. While expensive, these latter items were considered critical to the repair and upgrade of the Base facilities.

This approach—using short payback items, such as lighting, to subsidize the investment in longer-payback items so that a reasonable average payback period can be achieved—is common to both public and private-sector energy efficiency investments. However, in the public sector, it often represents a critical component of the project, since in many cases the dollar savings generated by an energy efficiency project, including energy cost savings and maintenance and management savings, may represent the only source of revenues available to pay for critical repairs and capital improvements.

Public facilities especially are in a position to benefit from the combined energy cost savings and maintenance and facility management savings generated through an energy efficiency project. At Hill AFB, CES/Way is maximizing the Base's total project savings by including a long-term equipment maintenance contract in the overall project cost. To reduce the Base's facilities management costs, the project design included a 575-point DDC energy management control system (EMS). The new EMS dramatically reduces facilities management time, since energy systems throughout the Base are tied in through a central computer, enabling maintenance staff to monitor and control those

systems from a central location. This not only reduces management time; it improves system performance by allowing immediate response to equipment problems or indoor climate issues. As a result, it also has greatly improved the indoor environmental quality for the Base's workers.

Under its long-term maintenance contract with Hill AFB, CES/Way has assumed all operation and maintenance responsibilities on mechanical and control systems affected by the scope of work implemented through the project. Daily operation is under the control of the new EMS, managed and maintained by CES/Way in conjunction with the facilities manager. Preventive maintenance on the equipment is included in the contract, with normal and emergency repairs handled on a case-by-case basis in cooperation with Base facilities maintenance.

CES/Way also has sought to maximize energy cost savings at the Base with an innovative cooling design and chiller configuration. Rooftop multizone air handlers were modified to operate as Variable Air Volume (VAV) systems with corresponding reductions in fan energy as well as optimum thermal efficiency. Additionally, the new chiller configuration operates with both variable flow chilled and condenser water systems, reducing pumping horsepower to a minimum.

This project is expected to save Hill AFB 4,934,753 kWh per year and to generate a total of $50 million in energy and maintenance and management savings over the life of the project. Of course, these savings are expected to continue after the project term. To ensure that the savings in fact are realized during the 15-year performance period, CES/Way has installed a real-time monitoring and verification system, employing NAESCO's M&V protocols. Lighting hours are measured with light loggers. Post-installation audits and EMS monitoring are also employed. To establish its baseline for savings measurement and verification, the ESCO audited lighting run hours. In addition, monitoring and data logging of control variables on mechanical systems formed the baseline conditions for modeling energy conservation opportunities using computer-based building energy simulation software.

ENHANCING THE COMPETITIVENESS OF AMERICAN BUSINESS AND THE EMPLOYMENT BASE OF THE U.S. ECONOMY

Saving Jobs and Creating Opportunities for New Ones by Using Energy Efficiency Retrofits to Reduce Operating Costs

Energy costs are a substantial component of fixed operating costs in the commercial sector, accounting for a substantial percentage of operations and maintenance costs in a typical commercial building. While energy costs, in the past, have been viewed as essentially

fixed, ESCOs are providing building owners and tenants the opportunity to reduce these costs, by an average of 25 percent. These energy cost reductions translate directly into an improved profit picture for commercial establishments. As the project undertaken at the Hunts Point Cooperative, described in Case Study 9 below, illustrates, energy efficiency capital improvements can play a key role in keeping a business in its present location and keeping it competitive. In this way, the employees who depend on that business for their livelihood benefit from increased job security.

Energy cost savings can translate into investments that yield new employment opportunities as well. As noted in the Introduction, it is estimated that within the U.S. economy, residential and commercial buildings consume one-third of all primary energy and 65 percent of all of the electricity we produce. Businesses and other consumers that take advantage of energy efficiency investments capture these savings for use elsewhere in the economy. If the United States were to achieve its projected capacity to reduce energy consumption through efficiency measures, the resulting dollar savings would enable U.S. consumers to increase their annual consumption and U.S. business to increase its annual output of nonelectricity goods and services by $45 billion. In addition to the jobs being created by the ESCO industry itself, this savings could translate into the creation of approximately 345,000 new jobs.[13]

Enhancing Real Estate Marketability

As noted throughout these case studies, energy efficiency upgrades not only translate into substantial economic benefits, they improve the quality and comfort level of the indoor environment, through improved lighting quality and climate control. Both building owners and tenants reap a dual benefit from these upgrades. Tenants enjoy lower operating costs while gaining a more comfortable work environment that is reported to contribute substantially to improved worker productivity. Owners reduce the costs of operating and maintaining their buildings, while finding that both the lower costs and more comfortable environment resulting from energy efficiency renovations enable them to retain tenants and improve the marketability of their buildings to potential tenants. In addition, an upgraded, low-maintenance building is more attractive to potential buyers. A striking example of the financial benefits resulting from the energy efficiency renovation of a commercial building is provided by the Community Towers twin office complex in San Jose, California.

Case Study 7: The Community Towers Complex (Viron Energy Services)[14]

The Community Towers Complex consists of two office towers encompassing a total of 350,000 square feet in the downtown business district of San Jose.

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[13] See "DSM and the Broader Economy," Edward Moscovitch, *The Electricity Journal*, May 1994.

[14] San Jose Community Towers, 111 North Market Street, Suite 400, San Jose, California 95113; Viron Energy Services, 216 NW Platte Valley Drive, Riverside, Missouri 64150.

The Great Western Bank Building (10 floors) was built in 1965, and the California Commerce Bank Building (12 floors) was built in 1962.

In the early 1990s, the owners of the Towers set out to lower their operations and maintenance costs, compared to other downtown area office space, so as to enhance the profitability of the property, with the ultimate goal of selling the property. While looking for a contractor to replace a set of unreliable chillers, the owners learned that energy and maintenance costs could be reduced through energy-efficient mechanical and lighting retrofits. They also learned that these upgrades would improve the work environment, including indoor air quality, for their tenants, further improving the marketability of their building.

The owners sought competing bids for a comprehensive energy efficiency retrofit from three companies. Within a month of receiving the bids, the owners selected Viron Energy Service (Viron), a subsidiary of York International, and signed a contract for the job. Typical of ESCO performance contracting, Viron provided the Community Towers with a comprehensive energy analysis, systems engineering design, construction management, training, performance monitoring, and post-installation maintenance.

Based on its initial energy audit, Viron estimated that the buildings were using an average of 1319 kW (4,372,316 kWh) of electricity and 100,291 CCF of natural gas per year. A subsequent comprehensive energy audit confirmed these figures. After assessing the condition of building equipment and its usage, Viron recommended and, upon approval by the customer, installed high-efficiency, brighter lighting systems. Troublesome pneumatic temperature controls were replaced. The air systems were converted to variable volume with digital zone control. A high-efficiency domestic water heater was installed. Two 500-ton-capacity 30-year-old unreliable hermetic CFC centrifugal chillers were traded for two 275-ton-capacity CFC-free high-efficiency rotary screw chillers. Finally, digital controls were installed on the central plant systems. This centralized system is controlled and monitored from a central location using a personal computer.

While most energy efficiency retrofits are based on ESCO or third-party financing, with repayment out of the customer's savings stream, in this case the building owners were able to finance the entire $1.4 million project themselves. Pacific Gas & Electric, through its demand-side management program, provided utility rebates totaling $262,484, reducing the net cost of the project by 19 percent. The owners financed the project over a seven-year period with a positive cash flow.

Under its contract with the Community Towers, Viron guarantees an annual energy savings of $175,000 and provides the customer an additional $20,000

in annual maintenance savings, for a total annual savings of $195,000. To support its energy savings guarantee, Viron provides electronic monitoring through the energy management system. A monthly report is sent to the Community Towers indicating the actual energy cost savings relative to the guaranteed savings.

The following summary of energy consumption for the two buildings demonstrates the dramatic reductions in energy usage available through energy efficiency retrofits.

CONTRACT BASELINE PERIOD:	Kilowatt-Hours Consumed	Therms Consumed
1992-1993	4,372,316 kWh	100,291 CCF

(Under the performance contract, the energy conservation measures were installed from June through December 1994.)

FIRST 12 MONTHS OF SAVINGS:	Kilowatt-Hours Consumed	Therms Consumed
(After construction phase)	3,039,241 kWh	62,084 CCF

Based on average costs of $0.10 per kWh and $0.60 per therm, in the first twelve months of 1995, these buildings reduced their utility costs by $175,000, based on calculations taken directly from the customer's electric and natural gas bills.

As a result of the energy efficiency retrofit, the Chief Engineer for the Community Towers, John Falvey, has noted a substantial reduction in maintenance time spent on emergency calls. "Hot and cold calls have been cut on average from about 10 a day to two or three. I used to spend three hours a day calibrating and adjusting pneumatic boxes and stats. Most of this work was done above the drop ceilings. Now I can monitor and make temperature and air flow adjustments at a PC in my office. Finally, I have time to handle the important maintenance needs of the buildings. I only wish we had done this years ago."

Similarly, Taylor Clayton, Vice President of Boccardo Properties, enthusiastically describes the benefits of comprehensive energy efficiency retrofits from a building owner's perspective. "York International introduced us to Viron's program to help us replace a couple of chillers that were a real liability. Viron encouraged us to look at not just the chillers, but the air systems, lighting, controls, et cetera. Viron's performance contracting offer was straightforward and the energy savings guarantee easy to verify. We like the idea that Viron was an engineering and contracting company focused on energy savings retrofits. Viron's program is not just about energy savings. I considered the energy savings as fuel for improvements to our business. The new systems—including chillers, comprehensive temperature controls and lighting—have

greatly benefited our customers. In the long and short haul this investment will help us renew our leases and bring new customers to our buildings. Would I do it again? Let me answer briefly: ABSOLUTELY!"[15]

Reducing Operating Costs While Improving Product Quality

The U.S. manufacturing industry has come to recognize the cost reduction and product improvement benefits associated with energy efficiency retrofits. As with commercial buildings, manufacturing facilities can apply energy-efficient technologies to reduce the cost of operating and maintaining their plants, in some cases avoiding the need to reduce their work force or enhancing their ability to invest in new jobs. In addition, manufacturers are taking advantage of more efficient equipment and energy management systems to improve not only the cost of their production processes, but also the quality and uniformity of their products.

The following case study illustrates the cost-reduction and product improvement benefits resulting from the combined application of comprehensive energy efficiency measures in the largest float glass manufacturing facility in the United States.

Case Study 8: Libbey-Owens-Ford's Glass Manufacturing Plant (Honeywell)[16]

Libbey-Owens-Ford's (LOF) Laurinburg, North Carolina, plant is the largest float glass manufacturing facility in the United States, producing 480,000 tons a year. The glistening sheets of premium quality glass are used in architectural and construction projects. Long considered a model of labor productivity, the plant, which is housed in a 1.3-million square feet facility built approximately 23 years ago, recently began focusing on additional aspects of operating efficiency and cost reduction.

As part of a search for ways to reduce its production and product costs, LOF management began discussions with Honeywell Home and Building Control in 1992. The investigations culminated in a major energy efficiency and equipment modernization project based on an energy savings performance contract.

LOF presented Honeywell with a number of challenges at the outset. The retrofit of existing energy-consuming equipment had to be self-funding, and the cost of the performance contract had to be recovered through savings in five years. In addition, the energy conservation measures had to be designed for a manufacturing process that had remained the same for 60 years.

[15] In addition to the substantial cost savings generated by this project, Viron's project engineers received an award from Energy User News on the Improved Indoor Air Comfort resulting from the work.

[16] Libby-Owens-Ford, Highway 74 Bypass East, Laurinburg, North Carolina 28352; Honeywell Inc., Home and Building Control, Honeywell Plaza, P.O. Box 524, Minneapolis, Minnesota 55440-0524

Changeovers had to be gradual because, in the glass business, a change in process today might not show up in the product for several weeks. Even so, savings had to be immediate while the risk to product quality had to be zero. Also, installation had to accommodate a plant that operates 24 hours a day, 365 days a year.

"Honeywell brought in a team of engineers who began working with our people right on the factory floor to find out how we ran our business," recalls plant manager Jim Meyer. "It was a partnership from the beginning. We knew glass and they knew energy savings. They asked a lot of questions before they began making recommendations."

Involving many aspects of environmental control, lighting and glass manufacturing, the recently completed project has improved product quality control while reducing energy and operating costs by $1.5 million annually.

The largest single source of energy savings—about $250,000 per year—can be attributed to variable-speed drive retrofits on fan systems. The new drives permit heavy-duty motors, which normally operate at 100 percent output, to be downshifted to match lesser loads. This reduces equipment wear and maintenance requirements as well as energy consumption.

The installation of high-pressure sodium lamps and electronic ballasts throughout the 1.25 million-square-foot building saved another $160,000 per year. The replacement lamps yield more light per watt expended and have a longer useful life. The revamped lighting system has also been equipped with a lighting control system that can program illumination levels according to the activity schedule in each area.

In the production area, programmable controllers were added to monitor and control critical temperatures during the float glass manufacturing process. A point-of-use dust collection system was also installed to improve indoor air quality at the plant and to keep airborne particles from contaminating the molten product. The efficient new dust collection system replaced a central system that ran continuously. The old system combined all waste material at one collection point. This material was then trucked to a landfill and discarded. The new system is automated and runs only when needed in certain areas. It then separates the particles, allowing LOF to reuse 95% of the material it previously threw away.

To monitor and control energy use and mechanical operations throughout the plan, Honeywell installed a digital facility management system. Its real-time graphic displays allow LOF operators to keep an eye on environmental conditions and receive prompt notice of equipment problems requiring immediate attention. The system's programmable software automatically

administers several energy management programs. One schedules space temperatures based on building occupancy so energy is not expended on vacant floor space. Another monitors total electric demand and sheds noncritical power loads to avoid demand peaks that would otherwise raise utility charges.

The equipment upgrades and process improvements are producing more than $1 million annually in operational savings in addition to the energy cost savings. These cost reductions have enabled LOF to make its primary products more cost competitive and to increase its output of other types of glass products.

With system retrofits accomplished, a five-year operating lease period began wherein energy and operating savings guaranteed by Honeywell are used to recover the lease payments. Only a portion of the $1.5 million saved annually will be needed for this purpose. The remainder will be retained by LOF as an addition to business cash flow. At the end of the five-year lease period, LOF will retain 100 percent of the energy cost savings.

Annual analysis of actual energy expenses will be tracked and compared to the guaranteed savings. In case of a savings shortfall in any of the five payback years, Honeywell will issue a check for the difference. "We've made some preliminary estimates of our first-year savings and it looks like they'll be greater than expected," Meyer says. "Beyond the portion we'll return to pay off project costs, the extra money will reduce our total cost of operations." Steve Kalosis, vice president of the LOF's Flat Glass Division has expressed an interest in extending the energy management partnership to the division's eight other manufacturing plants.

Typical of performance-based energy efficiency contracts, follow-up services are provided to keep the upgraded system running at peak efficiency and to assure the success of the savings program. Honeywell engineers conduct a monthly performance audit to assess the effectiveness of the technical applications and seek additional opportunities to save. LOF also receives preventive maintenance and 24-hour emergency service for all mechanical systems and controls, including a filter exchange service for the dust collection system.

Placing a technical resource manager at the site helps ensure that the glass manufacturer gets the greatest value from its investment. Honeywell RTM Mike Vrchota works in partnership with LOF management to help them attain their financial goals. Mike works with all staff levels in the organization to encourage efficient operating practices and maximum savings.

"We don't think of Mike as an outsider," said Meyer. "Our people have accepted him as part of the LOF family. He's our go-to guy on anything having to do with equipment operations and energy savings and he gets things done."

Improving Customer Satisfaction and Competitiveness in the Service Industry

The hotel industry is in the unique position of combining the needs of the commercial buildings sector with that of the industrial sector. The hotel owner's product is a building. Similar to commercial space, the building must offer the hotel's patrons a high quality of comfort in its indoor environment, including heating, cooling, lighting, water temperature and air quality, along with contemporary amenities. This product must be offered at a price that will attract patrons while allowing the hotel owner to control costs. As the following case study illustrates, even the owners of relatively new hotel facilities are finding that energy efficiency retrofits with state-of-the art equipment and technologies can greatly improve the profitability of their properties by improving the indoor environment while reducing operating and maintenance costs.

Case Study 9: The Hyatt Regency Buffalo (Power System Solutions)[17]

The Hyatt Regency in downtown Buffalo (the Hotel) is one of the largest hotels in the city. In the tradition of the Hyatt hotel chain, the Hotel offers the patrons of its 17-story, 400-room hotel a high-quality residential environment. However, because it is located in Buffalo, this Hyatt Regency must contend with the high energy costs associated with Buffalo's long and extremely cold winters. The Hotel is relatively new, constructed only in 1984. Nonetheless, an initial energy audit conducted by Buffalo's utility, Niagara Mohawk, in the early 1990s identified a number of opportunities for substantial energy and energy cost savings at the Hotel. As a result, the West Genessee Hotel Association, the owners of the Hotel, began looking for an ESCO that could work with them to develop an energy efficiency project providing a favorable cash flow.

The Hyatt chain provides its hotels with sophisticated techniques for tracking energy use and energy use patterns. In addition, the Hotel employs an extremely knowledgeable engineering staff. This technical capability, coupled with the information provided by the Niagara Mohawk energy audit, enabled the Hotel to enter the energy efficiency marketplace armed with a great deal of knowledge about the hotel's energy use and its needs in terms of energy efficiency technologies. What the Hotel lacked going into this project was a source of funds to finance the project. Therefore, it sought an ESCO with excellent technical credentials that could bring project financing to the table. Power System Solutions (PSS) fit these criteria.

[17] Hyatt Regency Buffalo, Two Fountain Plaza, Buffalo, New York 14207; Power System Solutions, 9185 Bond Street, Overland Park, Kansas 66214.

While the Hotel had its initial energy audit conducted by Niagara Mohawk in hand, as is standard in the industry, PSS conducted its own comprehensive, or investment-grade, energy audit before sitting down with the Hotel's engineering staff to work out the final project design and estimated energy savings. Using the initial energy audit, the Hotel's engineering staff had determined the types of equipment they believed were appropriate for the facility. After conducting the comprehensive energy audit of the 369,207 square feet building, PSS provided the Hotel with a written Energy Management and Energy Audit Program, detailing the minimum 1.4 million kWh and $100,861 available to the Hotel in energy savings based on specific equipment changes and the use of an energy management system. For this project, PSS and the Hotel agreed to the installation of variable-speed drives on the Hotel's ventilation fans, water pumps and the cooling tower. In addition, PSS installed a run-around-loop heat recovery system, along with a direct digital energy management control system, pneumatic controls and a complete high-efficiency lighting retrofit.

As part of its comprehensive energy audit, PSS includes a baseline of energy consumption for a typical twelve month period. This baseline serves two purposes. It establishes the current energy use, and it is used to measure the level of energy consumption savings available in the facility. The baseline is developed using energy consumption data gathered for a period of several years prior to the initiation of the project, along with an analysis of current use patterns. In addition, measurements of specific equipment are incorporated. In this case, PSS included light level measurements, enabling it to factor lighting quality into the project design.

The Hotel was able to assess the product it was to receive using PSS's description of the standards of services and comfort (levels of heating, lighting, cooling, etc.) to be maintained in the building. Using the audit data, the contract between PSS and the Hotel also set forth the level of energy unit savings, converted to dollars based on the Hotel's energy unit cost. PSS guaranteed the Hotel a savings of approximately $100,000 per year on its energy costs. Since the completion of the installation in the Spring of 1994, the Hotel has actually saved approximately $160,000 per year on its energy costs.

Because PSS agreed to finance the project on behalf of the Hotel, PSS also provided a financial analysis, using financial parameters developed in cooperation with the Hotel. Using rebates from the Niagara Mohawk demand-side management program in place at the time, PSS was able to finance this project over a period of 48 months.[18] The Hotel has enjoyed a positive cash flow from this project since day one, using only a portion of its energy savings

[18] This demand-side management program is no longer in place.

to make the finance payments. At the end of four years, the Hotel will own the equipment and 100 percent of its energy savings.

In addition to the comprehensive energy audit and financing, PSS provided for the installation of all of the equipment over a six-month period and arranged for follow-on maintenance for certain of the systems. PSS also monitors project performance to ensure that energy use reduction targets are being met. This ongoing measurement of performance gives the Hotel a reliable basis for evaluating the project.

For this project, the energy management system and variable-speed drives were considered essential components because of the way the Hotel's space is used. Unlike an office building, where use is consistent from day to day, the Hotel contains several thousand square feet of meeting space in addition to its standard hotel rooms. The use of this meeting space varies tremendously from day to day. One day it might be fully occupied; the next day, it could be empty or only partially occupied. Without an energy management system in place, this space was continuously heated and cooled regardless of use.

The installation of an energy management system has enabled the Hotel's engineers to match energy use to the use of the building. The system, which employs user-friendly software and is operated from a central personal computer, is used to schedule areas for conditioning (heating or cooling and lighting) depending upon scheduled use. The system automatically brings only the space scheduled for use to a preset temperature prior to occupancy. In addition, if occupants request changes in temperature or air flow during use, these changes can be accommodated automatically by the engineers from the central computer, without affecting other areas.

According to Stephen Fitzmaurice, Director of Engineering for the Hotel, "The energy management system has greatly increased the efficiency of our building without any decrease in our services. The energy efficiency retrofit has been a tremendous success here. While we had a good idea of what we wanted, there was no way we could have accomplished it without an ESCO to bring in the financing. It was only because of the financing arrangement that we were able to do this project."

With the Advent of Competition in the Energy Industry, Energy Efficiency Services Have Become a Key Factor in Utility Competitive Advantage

With the passage of the Energy Policy Act of 1992, the U.S. Congress opened the door to deregulation—and hence, competition—in the energy industry. As the following case study illustrates, high-quality, creative energy efficiency services are becoming a key factor in achieving competitive advantage in the newly deregulated energy industry. Utilities, now entering an era of competition for their customer base are finding that the difference between retaining and losing a large customer may turn on the ability to provide the highest

quality, lowest cost energy efficiency services. In this new environment, the Hunts Point project represents the perfect win/win situation for a large energy user and a proactive utility. NYPA's timely response to a major customer's needs will ensure its keeping the Market as a NYPA customer for years to come, while the Market's capital improvements and reduced operating costs will ensure that it retains its status as a valued employer in the New York area.

Case Study 10: The Hunts Point Cooperative Market (HEC Energy and Design Services)[19]

The Hunts Point Cooperative Market (the Market), located on 50 acres in the Bronx leased from the City of New York, consists of three refrigerated meat-storage and processing buildings and one frozen food warehouse totaling half a million square feet of floor space, the largest food distribution center in the world. The Market provides a cold storage environment that allows tenants to meet U.S. Department of Agriculture standards for the processing and handling of meat products. Faced with an aging, inefficient refrigeration plant, rising utility and maintenance costs, and increased refrigerant costs due to the phase-out of CFCs, the Market in 1995 began looking for a way to upgrade its aging refrigeration plant, but was financially constrained by short-term cash needs.

The Market had entered into a contract to purchase its electricity from the New York Power Authority (NYPA). However, the competing electric and gas utility offered to help build and finance a new gas-fired ammonia refrigeration facility for the Market in return for the Market's switching to that utility as its electricity provider. Responding to this threat to its load, NYPA, which was starting an industrial Demand-side Management program to help New York businesses grow and increase employment, asked HEC to bid on a project to design a competing offer that would enable NYPA to retain the Market as its customer.

It is unusual for an ESCO to bid on a project based on an energy audit conducted by a third party. In this case, however, NYPA previously had requested an audit by an outside consulting firm. Using the results of that audit, HEC developed a turnkey, design-build plan for an upgraded refrigeration plant and a number of energy efficiency measures.

A common practice in the ESCO industry is to monitor savings from a project after installation and to measure these savings against a pre-installation baseline. It also is becoming common for the ESCO to guarantee a certain minimum level of savings—i.e., the ESCO makes up the difference if that minimum

[19] Hunts Point Cooperative Market, C101-355 Food Center Drive, Bronx, New York 10474; HEC Energy and Design Services, 24 Prime Parkway, Natick, Massachusetts 01760.

level is not achieved. HEC's proposal included the establishment of a pre-installation baseline and post-installation monitoring of all energy efficiency measures to ensure that projected savings from the baseline are realized. This, along with HEC's guarantee of a minimum level of savings for the project added to the Market's confidence in the NYPA/HEC proposal, further enhancing the competitiveness of that proposal. Ultimately, the Market opted for the NYPA/HEC electric option, and HEC was able to assist Hunts Point and NYPA in developing an energy project that gave the Market a positive cash flow.

Once its proposal was selected, HEC conducted its own comprehensive energy audit of the facility. Based upon this more rigorous analysis of energy use and potential upgrades, HEC proposed an alternate scope of work involving the replacement of the existing CFC refrigeration system with a new CFC-free ammonia refrigeration system, as well as a number of other measures that substantially increased energy savings and overall cash flow for the project. According to James Redden, HEC's Vice President of Operations, "When we first looked at this plant we knew that major energy cost reductions were going to be possible. The 1200-hp refrigeration compressors were in hot gas bypass mode and the 350-hp pumps were being throttled."

In all, HEC was able to reduce the Market's projected energy consumption an additional 30 percent below estimates based on the initial energy audit and to increase overall project cash flow by 200 percent. Given the results of HEC's comprehensive audit, the Market accepted the revised proposal. Upon final contract award, HEC assumed complete responsibility for design, bidding, construction management, and commissioning of the project.

In addition to the new CFC-free ammonia refrigeration plant, HEC provided the Market with an energy-efficient lighting retrofit, a new powerhouse building, new compressors, brine pumps, evaporative condensers, and a new direct digital control (DDC) system to optimize the energy performance. The new two-stage ammonia system operates at a more efficient level than the old system to provide high- and low-temperature brine for distribution throughout the Market. There are two separate brine loops, one at 19°F and one at -20°F for cooler and freezer refrigeration. Operated by microprocessor-based controls, the system includes three electrically driven low-temperature screw compressors, three electrically driven high-temperature screw compressors, new brine pumps and evaporative condensers.

Bruce Reingold, General Manager of the Market, noted the difficulty in working with the Market's previous cooling system. "It was technologically inferior. Our engineering staff was forced to engage in a huge amount of guesswork with respect to adjusting brine temperature, regulating brine flow pressures, and setting defrost cycles to try to satisfy the needs of the tenants in the Market while maintaining the efficiency of the plant. With this new fully

automated system, tied into a microprocessor, we anticipate very positive, quantifiable results."

Persistence, patience, and the expertise of professionals all were needed to get this project from conception to construction. However, with the new CFC-free ammonia refrigeration plant and energy-efficient retrofits, the estimated annual electric bill savings for the Market is $427,000, or about 6.7 million annual kWh savings. According to David MacIntosh, Manager of Projects at HEC, the new two-stage ammonia system is much more efficient than the old single stage system. The old system operated in the range of one to two kW/ton, while the new system will operate in the range of 0.5 to 0.8 kW/ton.

The total cost of this all-electric project design was $5.8 million, substantially lower than the competing gas-driven system, and NYPA agreed to finance the new project over a period of ten years. The Market also will receive an industrial conservation credit from New York City of $530,000 per year for the next eight years and declining amounts for up to 12 years.

HEC also constructed a new powerhouse for the new motor-driven plant, providing the Market with the added benefit of using the old powerhouse as rental space, estimated to yield approximately $170,000 annually in increased revenue. With this, the total annual cash flow from this project is estimated at $1.13 million for the first eight years, with a total project cash flow of $24 million over 25 years.

In Bruce Reingold's view, these very beneficial results were the product of the teamwork approach that HEC and NYPA brought to the project. "From the inception of this project, going back well over a year, both NYPA and HEC have allowed the needs and concerns of the Market to be of paramount importance—from the initial planning stage, through bidding and construction, to the training of our staff, communicating to our tenants and Board of Directors, to the final phase of going on line. There was never a single issue, regardless of its operational magnitude or financial commitment, that was not dealt with professionally and swiftly by both HEC and NYPA in a manner that was consistent with the needs of the Market. From their sensitivity to our cash flow requirements to the layout of comfortable and efficient offices for our maintenance staff, both NYPA and HEC created an environment that was both flexible and effective to serve our short-term as well as long-term goals."

Not only has this project produced a satisfied customer for NYPA, it also has solidified the Market's position within the meat industry. As Reingold noted, "The positive expectations of this project are shared throughout the entire meat industry as this new state-of-the-art, energy-efficient ammonia refrigeration plant will help ensure this Market as the home to the meat industry in the tri-state area for years to come."

Tailoring Financing Packages to Meet the Energy Efficiency Retrofit Needs of American Business

As we have seen, one of the critical elements of energy efficiency upgrades is financing. Because these can be costly projects with relatively long payback periods, few enterprises are in a position to finance them out of working capital. ESCOs have added to their portfolio of energy expertise, energy-efficient technologies and contracting services the provision of financial packages that often can be tailored to meet a customer's needs.

Case Study 11: United Parcel Service (Public Service Conservation Resources Corporation)[20]

When United Parcel Service (UPS) set out to implement an energy-efficient lighting upgrade in 13 of its New Jersey facilities, it sought an approach that would minimize, if not eliminate, its out-of-pocket cost for the project. Public Service Conservation Resources Corporation (PSCRC) and its joint venture partner, Lighting Energy Savings Systems and Associates, working through the Public Service Gas & Electric Company's (PSE&G's) Standard Offer programs, were able to offer UPS the high-efficiency capital improvement for approximately 20 percent of the total $1.4 million cost of the project. Under the Standard Offer program guidelines, PSCRC arranged for PSE&G to purchase measured energy savings from UPS over time.

The performance of UPS's new lighting system will be monitored for a ten-year period via nonintrusive equipment which communicates with a central database to report "on" and "off" times in a sampling of differing end-use groups. The kilowatt reduction associated with each end-use group is multiplied by the hours of operation recorded and applied against the Standard Offer rate table to determine the value of the savings being delivered.

PSCRC calculated the ten-year cash flow stream of Standard Offer revenue based on UPS's intended hours of operation and the actual kilowatt reduction achieved, discounted that amount to the NPV of $1.2 million, which was then paid directly to UPS upon project completion. In return, UPS has committed to operate its lights in accordance with a schedule it has determined and has included within its contract exhibits. UPS will be paid for any performance in excess of its committed operating hours and must make up for any shortfall.

In addition to receiving the high-efficiency capital improvement at minimal cost and improved lighting conditions at its facilities, UPS will receive the benefit of approximately $448,000 in annual bill savings resulting from the increased efficiency of the new lights.

[20] United Parcel Service, Inc., 4 Gatehall Drive, Suite 360, Parsippany, NJ 07058; Public Service Conservation Resources Corporation, 9 Campus Drive, Parsippany, New Jersey 07054.

EXPANDING BEYOND TRADITIONAL TECHNOLOGIES AND SERVICES

Energy Efficiency and Cogeneration

While the ESCO industry's roots are in the installation of energy-efficient lighting, energy management systems, and energy-efficient heating and air conditioning, the industry very quickly moved into the installation of efficient motors and variable-speed drives. In recent years, opportunities for unique applications have enabled the industry to move into areas that blur the lines between production and efficiency. Using a synergistic blend of production technologies and efficiency technologies and measures, these innovative designs reduce energy consumption and cost far below levels available through the use of one type of technology or the other.

Typical of the innovation found in this industry are the projects analyzed in the following two case studies. At the University of Rhode Island, NORESCO in 1985 moved from traditional energy efficiency services to combining cogeneration with energy efficiency measures in a single project. A few years later, SYCOM Enterprises took the industry into new territory using a waste gas as fuel in a waste-to-direct-drive process representing the next generation of the traditional waste-to-energy cogeneration model.

Case Study 12: The University of Rhode Island (NORESCO)[21]

The University of Rhode Island (URI), originally built in 1893, now comprises 73 buildings totaling more than three million square feet. In the mid-1980s as tuition competition among universities was on the rise, URI began to look for ways to reduce its operating expenses in order to become more cost-competitive with other universities in the area. A review of URI's operating systems revealed deteriorating underground and steam condensate pipes and high rates of operating failure in building air-conditioning systems, the boiler system, domestic hot water systems and overall energy systems.

Working through the Rhode Island State Energy Office, URI published a request for proposals in 1985 for companies to bid on a renovation to its operating systems. Approximately four companies responded to the RFP and NORESCO, with a proposal that combined an energy efficiency retrofit with the installation of several cogeneration units, was chosen for the project.

According to William G. Ferguson, Rhode Island's State Wide Energy Conservation Control Officer, "We had a lot of data on energy use at URI and we knew that energy savings were available there, but we needed a company that could provide both financing and technical expertise to help us pull those savings out. We also wanted to improve the University's cash flow as

[21] The University of Rhode Island, Kingston, Rhode Island 02881; NORESCO, Point West Place, 111 Speen Street, Framingham, Massachusetts 01701.

quickly as possible, so we were looking for a project that would allow URI to retain the majority of the energy savings generated by the project from day one. In addition, URI had a preference for the specific vendor to be used for at least one of the energy conservation measures proposed for the project."

Working with URI over an eight-month contract negotiation period and a five-month installation period, NORESCO designed and installed a project that included the energy efficient lighting retrofit of 1600 indoor light fixtures; the installation of a 1500-point energy management system to reduce winter heat demand; the installation of energy-efficient motors, chillers, condensate feed pumps, boilers and hot water heaters; and outside lighting. NORESCO also installed four cogeneration units ranging from 60 kW to 180 kW, and used the energy savings generated by the project to finance the installation of approximately three miles of underground steam and condensate lines.

Different energy efficiency measures pay for themselves at different rates. For example, a lighting retrofit typically has a payback period of one to two years because of the level of savings generated relative to the cost of the equipment. Conversely, items such as URI's steam distribution lines could have a payback period of 15 to 20 years. The comprehensive energy efficiency/ cogeneration retrofit at URI enabled NORESCO to use the short payback on the items like lighting to mitigate the cost of the longer-payback items. This tradeoff, combined with approximately $400,000 in lighting rebates provided by Narragansett Electric, resulted in a project that was financed by NORESCO over a period of ten years, using only 20 percent of URI's monthly energy savings generated by the project.

By taking the step of combining cogeneration with an energy efficiency retrofit, NORESCO was able to maximize URI's energy savings. Three small cogeneration engines are now used to provide electricity and hot water in URI's dormitories and a larger unit provides electricity to the campus main grid, with waste heat used for the main boiler plant.

In the cogeneration applications, a natural gas-fired engine is used to power a generator that produces electricity. The heat by-product from this engine is then diverted to a productive application. At URI, waste heat from the cogeneration engines is used to heat water.

URI's dormitories depend on electricity for both lighting and heat. Installation of the three 60-kW cogeneration engines at the dormitories has enabled the University largely to displace the electricity formerly purchased for these purposes. The cogeneration units now provide the base load for lighting and heating the dormitories, with electricity from the grid used as backup on peak days when demand exceeds the capacity of the cogeneration engines.

In addition, in the cogeneration application, the heat from the engines is now used to heat the water for the dormitories, displacing the 129 kW of electric resistance heat formerly used to heat the water.

The largest cogeneration unit installed at the University is a 180-kW engine tied directly to URI's power grid and used to displace electricity formerly purchased from the utility. The heat by-product from this engine is diverted to preheat water for the campus main boiler plant. By preheating the water using the cogeneration unit, URI is able to reduce substantially the amount of energy required to heat the main boiler.

The combined $5.5 million energy efficiency/cogeneration project installed by NORESCO at URI has reduced the University's energy demands by 8,730,000 kWh and 490,000 gal of oil equivalent (net gas and oil) annually, for an energy cost savings of more than $1 million per year.

William Ferguson of the State Energy Office found this project to be a positive experience. "NORESCO was a very good company to work with. They really cooperated in creating a partnership on this project. We never felt that this was a situation where the company was only looking for a profit. They were consistently concerned about URI's objective of cutting costs to the maximum extent possible and about the comfort of the people using the facility. They worked very carefully to make sure that these objectives were met fully. This gave us a lot of confidence in the project."

Waste and By-Product in a Direct-Drive Energy Efficiency Application

It is axiomatic that competition drives innovation. As a corollary to this, successful applications of innovative ideas open the doors to new markets or to the expansion of existing markets. In the energy efficiency marketplace, ESCOs are applying existing concepts in new ways and creating exciting new applications to continuously push the envelope of energy efficiency.

Fuel switching has long been a component of the energy efficiency retrofit process. This application generally involves a switch from electricity to gas. In the pursuit of ever more creative energy efficiency applications and designs, however, one ESCO has taken the step of combing fuel switching with waste and energy recycling, virtually eliminating the need for an outside fuel source.

Case Study 13: The Bergen County Utilities Authority Wastewater Treatment Facility (SYCOM Enterprises)[22]

The Bergen County Utilities Authority (BCUA) is a wastewater treatment facility in Bergen County, New Jersey. The facility, encompassing approximately 120 acres of land and including seven buildings, is the third largest wastewater treatment facility in the state of New Jersey. The buildings are connected by underground tunnels, which also house a number of motors and pumps. A substantial amount of the facility's energy use comes from the operation of four aeration blowers, which previously were driven by four electric motors—two of the motors used as base load and two as backup.

In 1994, the BCUA began looking into ways to expand its power supply to accommodate an increase in wastewater being pumped to the plant for processing. Initially, a cogeneration plant, requiring an investment of approximately $8 million, appeared to offer the needed increase in power supply. However, in the process of investigating this cogeneration option, the BCUA also learned of the availability of energy efficiency retrofits which could reduce its current energy needs and thus effectively expand its existing capacity. The BCUA was intrigued by the opportunity to use an energy efficiency retrofit as a means of making capital improvements to its facility while reducing its energy costs.

In order to gather information on available technologies and project design options, the BCUA advertised a request for qualifications for an energy services company to act as its energy conservation/efficiency consultant. Eight companies responded to the RFQ. SYCOM Enterprises (SYCOM) was the company selected for contract negotiations, which were completed in approximately three months.

Based on its initial (precontract award) energy audit and the use of traditional energy efficiency technologies and applications, SYCOM and its engineering contractor, Stone and Webster, estimated that the BCUA could save approximately 2700 kW and approximately $476,976 in energy costs each year. These savings were to be based primarily on a fuel switch, to be accomplished by replacing one of the base-load electric motors used to drive the aeration blowers with a natural gas engine and adding a new engine blower set. Both engine-driven blowers would be used as base load. In this design, the three remaining electric motors became the backup to the gas engines.

[22] Bergen County Utilities Authority, Foot of Merhoff Street, Little Ferry, New Jersey 07643; SYCOM Enterprises, 109L Corporate Boulevard, South Plainfield, New Jersey 07080.

While the BCUA was impressed by SYCOM's proposal, following contract award, as SYCOM conducted its comprehensive energy audit, additional opportunities to reduce the BCUA's energy consumption became apparent to SYCOM's engineers. They quickly identified the opportunity to use methane gas, the principal by-product of the wastewater treatment process and a source of pollution from the facility, to power the new natural gas engines installed as base load to drive the aeration blowers. Fuel use was further reduced by directing the heat from the waste-gas-driven engines to replace the facility's boilers, in a cogeneration-like application. With this application, the facility has substantially reduced, and in the summer months virtually eliminated, the need to purchase fuel to drive the aeration blowers. The natural gas service was retained so that natural gas can be used as a secondary fuel source when the methane waste gas is insufficient to handle the full load. The electric motors remain as backup, used only when one of the gas engines is down for service.

With the above redesign, SYCOM was able to offer the BCUA a savings of 2300 kW per year, a slight decrease from the intial energy audit, but easily accepted since the use of the methane waste heat to drive the gas engines almost doubled the project's dollar savings. This innovative design increased the BCUA's projected savings from $476,976 to $942,319 per year, with an estimated total net energy savings over the fifteen-year life of the contract of $14,134,785.[23] Dominich Aiello, Project Development Manager at SYCOM, was thrilled that his company's engineers were able to work with the BCUA engineers to design such a creative and efficient project. "Not only were we able to solve their immediate capacity needs, we cut their energy use so far that they have enough capacity for even greater expansion in the future. We also were able to do it for them at no cost to the Authority, since the PSE&G Standard Offer payments covered the entire cost of the project, including the two new gas engines. This project will save the BCUA's ratepayers a lot of money. It gives you a great feeling to be able to do something like this."

The "Standard Offer" payments referred to are available because of SYCOM's participation in the Public Service Gas & Electric (PSE&G) demand-side management program, referred to as "Standard Offer." Since SYCOM was able to use PSE&G's payments under the Standard Offer program to cover all costs associated with the project, the BCUA received the capital improvement at no cost and was able to keep 100 percent of the energy cost savings generated by the project from day one. In fact, the savings generated by this project are so great that they not only created future capacity for the BCUA, but PSE&G's Standard Offer payment for the project actually exceeds the

[23] This net figure includes the facility's increased gas cost resulting from the fuel switch. Of course, the BCUA will continue to enjoy 100 percent of these savings afer the end of the contract term.

project cost. As a result, on top of its free capital improvement and energy cost savings approaching $1 million per year, the BCUA is receiving a rebate from the utility of approximately $870,000—all of these savings translating into lower utility bills for the BCUA's customers.

This project is exciting from both a financial and an engineering perspective. According to Rueben Weisberg, SYCOM's Director of Engineering, "This is the first energy efficiency project to employ a direct drive—as opposed to cogeneration—application based on a waste gas driven engine. This is as close as we can come with current technology to a perpetual motion machine."

"This project has worked out very well for the BCUA," notes Jerry Sheehan, Chief Engineer for the BCUA. "The availability of PSE&G's Standard Offer payments really made the project attractive. We also have found that by working with SYCOM under the Standard Offer program, the project has moved much more quickly than improvements done through our normal procurement process using traditional consulting engineering firms. But quality has not suffered. SYCOM's engineers have been right with us at every step to help design a project that both reduces our energy costs and improves the reliability of our equipment."

Added to its list of benefits, this project design also carries substantial environmental bonuses. The new process involves the capturing and cleaning of the methane waste gas to remove and neutralize its sulphur content before it is burned to drive the gas engine. As a result, the methane gas by-product, a pollutant previously emitted by the facility, has been eliminated entirely. This process has reduced NO_x and sulphur emissions in an amount sufficient for the project to qualify for emission reduction credits in New Jersey. As one of its services on the project, SYCOM is handling the application to the New Jersey Department of Environmental Conservation for those credits on behalf of the BCUA.

Case Study 14: Fort Polk, Louisiana (Co-Energy Group)[24]

In 1994, the Fort Polk military base faced a financial crisis. According to 1st Lt. John Boyd, assistant Installation Energy Conservation Program management officer, "We're in a money crunch right now. We've only got $13 million total dollars to spend on energy in fiscal year 1994. After that, energy costs come out of training dollars or salary dollars, which is what we're trying to avoid."

Looking for a way to substantially reduce its energy costs, rather than sacrifice its services or cut into salaries, the Fort Polk command turned to the Energy

[24] Fort Polk Energy Officer, AFZX-PW-EP, Building 2502, Fort Polk, Louisiana 71459; Co-Energy Group 725 Arizona Avenue, Suite 206, Santa Monica, California 90401.

Services Industry, issuing a request for proposals for a shared energy savings contract. Co-Energy Group (CEG) was the company selected through the competitive bid process.

Since half of the energy bill at Fort Polk was being spent on housing, CEG and the Fort Polk Energy Officers focused on ways to reduce energy costs in the Base's 4,003 family housing units. Thus, the project design called for the replacement of 4,003 existing HVAC systems with highly efficient closed-loop geothermal heat pumps. In addition, CEG installed other energy/water conservation programs, proven to be successful in previous similar installations. These included the replacement of approximately 75,000 interior and exterior lighting fixtures with energy-efficient compact fluorescent lights, improved insulation, the use of low-flow hot water outlets, and hot water generation using heat from the heat pumps. Because the majority of the work, which took place over an 18-month period, was concentrated in housing units, CEG met with residents at the outset to make sure that they understood the project and to solicit their input on ways to minimize any adverse impact from the construction work.

The geothermal heat pumps used in this project are highly efficient but relatively new and expensive. At the time the order was placed, this one project represented 10 percent of the annual unit shipments of the entire geothermal heat pump industry. According to David Aldridge, U.S. Army Corp of Engineers-Huntsville Division, "Given the shared-savings incentive inherent in the performance contract, it was felt that the ESCO would be motivated to use the high visibility of the project and the large quantity of heat pumps involved to negotiate costs aggressively with suppliers and manufacturers, thereby benefitting both the government and the ESCO." Aldridge's words proved to be prophetic. The project has achieved the best pricing the industry has ever seen for heat pumps in geothermal applications, ground heat exchangers, and the indoor installation. Since geothermal systems have no outdoor units or defrost controls, and the retrofit construction will result in same-vendor systems everywhere, maintenance savings (another service provided by CEG) are also expected to be large.

Because energy use in the housing complex was so extensive, CEG was able to reduce usage by an estimated annual 32,000,000 kWh. In addition, over 3,000,000 gallons of water are also expected to be saved through this project each year. "All of this with no sacrifice in the comfort of the housing. At the completion of construction the lighting, air conditioning and everything else will be better than what's in housing now," said Don Laurent, Installation Energy Conservation Program management officer. Occupants won't notice any change in the standard of living, yet the government expects to receive 35- to 40-percent reduction in energy costs.

The region also will enjoy cleaner air as a result of this project. This one energy efficiency retrofit alone is expected to reduce annual air emissions by 32,109 tons CO_2, 145 tons SO_2, and 86 tons NO_x.

The project financing was arranged by CEG over a 20-year period, during which CEG also retains responsibility for maintaining the equipment and measuring and verifying the savings. "That's one of the big advantages of a shared energy savings contract," Laurent pointed out. "The government doesn't incur the initial cost of the equipment—the contractor does. That frees up our energy and construction dollars."

In addition to providing Fort Polk with the needed savings in its energy costs and substantially improving air quality in the area, CEG hired local contractors and employees for the construction and maintenance work. According to U.S. Army Corps of Engineers figures, the project is expected to pump $25 million into the local Fort Polk economy over the next 20 years.

CUSTOMIZING ENERGY SERVICE SOLUTIONS FOR PUBLIC AND PRIVATE SECTOR CUSTOMERS

Attracting Businesses and Jobs to Local Jurisdictions Using Pollution Reduction Credits

Along with direct cost savings, reductions in energy use also provide a means of enabling local governments to reduce air pollution in their jurisdictions. With the sophisticated measurement and verification technologies now available through the energy services industry, ESCOs can translate reductions in energy consumption into measurable reductions in power plant air pollutant emissions. In areas where air quality is a concern, this can create opportunities for attracting new business into the jurisdiction without exceeding air emission levels.

In a unique venture with SYCOM Enterprises and United Jersey Bank, Mercer County, New Jersey, has taken the lead nationwide in developing a program that provides for the energy-efficient retrofit of all public facilities in the County and the banking of the utility air emissions reductions resulting from the reduced energy consumption. These verified emissions reductions, in turn, are being used to attract new businesses to the County. The net result for the County is a renovated building stock, reduced energy costs, cleaner air and an increased tax base.

Case Study 15: Mercer County, New Jersey (SYCOM Enterprises)[25]

After learning about the services available through the ESCO industry, Robert Prunetti, Mercer County Executive Director, envisioned a countywide energy efficiency program providing a vehicle for all public entities within the county to reduce their energy costs and upgrade their facilities at minimal expense to the individual agencies and facilities. Mr. Prunetti also had the foresight to realize that by developing this program, his county could serve as a role model for other counties in New Jersey and across the nation.

Through an informal solicitation, Mercer County (the County) selected SYCOM Enterprises (SYCOM) to work with it to develop this program. In October 1993, the County entered into a contract with SYCOM to provide energy services under the Extraordinary Unspecifiable Services (EUS) provisions of New Jersey's public bidding laws. SYCOM proceeded to audit all county facilities and to prepare energy efficiency proposals for each. The County then extended its Program to cities and townships in the County and to educational institutions. SYCOM is now presenting the Program, along with Public Service Gas and Electric's (PSE&G's) Standard Offer demand-side management incentives, to each of these entities. On behalf of the County, SYCOM conducts a public bid for labor and materials for each project in the program, including preparing bid specifications and providing advice during the construction phase of the project.

While working with Mercer County, SYCOM completed its first project with the State of New Jersey, following selection through a competitive process. The success of this project has led the State to become a participant as well in the Mercer County program, so that the majority of State buildings in the County now will receive energy efficiency upgrades as well. Given the volume of projects in the County, SYCOM and the County worked with the Mercer County Improvement Authority (MCIA) to arrange for a pooled financing of all non-State public energy efficiency projects in Mercer County. State projects are being financed through the New Jersey Economic Development Administration.

SYCOM employs the New Jersey Measurement and Verification Protocols for all projects in this program. Because of the reliable monitoring and verification of energy savings, Mr. Prunetti's administration, working with SYCOM and United Jersey Bank (UJB), has taken the additional step of creating the first-of-its-kind Emission Reduction Bank. UJB received a block of credits resulting from the installation by SYCOM of high-efficiency lighting in five of its buildings and UJB then donated the credits to get the bank up and running.

[25] The County of Mercer, 640 South Broad Street, Trenton, New Jersey 08658; SYCOM Enterprises, 109L Corporate Boulevard, South Plainfield, New Jersey 07080.

The emission reductions come from energy savings, which, in turn, reduce air pollution created by electric power plants. These emission reductions are transferred from participating companies like UJB to provide the emission credits needed to attract new businesses to Mercer County. The County works with the utility, PSE&G, as a borrower from this Emission Reduction Bank, providing credits to firms so they can comply with existing stringent state and local environmental regulations.

"I suppose it makes perfect sense for us to be the pioneer in energy banking," said Ron Phillips, UJB Financial Senior Vice President for Corporate Facilities, "even though we didn't set out with that goal in mind. We simply wanted to promote job creation in Mercer County, where we have our corporate headquarters."

According to Robert Prunetti, "Without SYCOM and United Jersey Bank, Mercer County wouldn't have been able to start this ambitious program. It's a great example of the public and private sectors using their talents and imagination, working together to stimulate economic development. Attracting new business and helping older ones comply with regulations and stay open helps the whole community."

Meeting Challenges Presented by a Facility's Configuration

The following case study demonstrates how a single energy efficiency retrofit can be accomplished in a project involving a large number of different facilities and locations.

Case Study 16: Chino Unified School District (Onsite Energy)[26]

The Chino Unified School District (CUSD) in Southern California encompasses facilities at 26 different locations and ranging from 20 to 30 years in age. After learning that an energy efficiency renovation could provide a means of replacing and updating its mechanical equipment, some of which was original equipment, CUSD published a request for qualifications for an ESCO to design a project that would save energy and provide new mechanical equipment throughout its 26 locations.

Onsite Energy was selected for the project through the RFQ process. Following a two-month contract negotiation, Onsite undertook an audit of the facilities that revealed a level of energy consumption of greater than four million kW and 14 million kWh per year. For this project, the mechanical design actually was quite straightforward, calling for the installation of energy-efficient lighting, with new fixtures, reflectors and ballasts in all facilities; modifications and

[26] Chino Unified School District, 5130 Riverside Drive, Chino, California 91710; Onsite Energy, 701 Palomar Airport Road, Suite 200, Carlsbad, California 92009.

replacements to the heating and air-conditioning system; and the installation of an energy management system.

The true challenge at CUSD resided in the sheer size of the project, given the 26 different locations. Ultimately, installation of the energy efficiency measures required over two years to complete. However, Onsite was able to reduce overall energy consumption in the School District by more than $600,000 per year, with a projected total project savings of over $6 million over the 10-year life of the CUSD-Onsite contract.

Measurement and verification of energy savings are common components of energy efficiency projects. Despite the large number of locations involved in this project, the technologies and sampling methods used to gather post-installation energy consumption data were readily applicable to the project. Therefore, throughout the 10-year contract period, CUSD receives monthly reports verifying the energy savings created by its new equipment.

Reducing Therms as Well as Kilowatts

Energy efficiency retrofits are often thought of in terms of ways to reduce electricity consumption. While it is true that electricity consumption, especially electricity for lighting, is dramatically reduced through energy efficiency retrofits, gas consumption and costs can be reduced substantially as well. In the following project, the ESCO was able to meet a university's needs to reduce energy costs in order to make more financial resources available for academic programs, by cutting both electricity and gas consumption.

Case Study 17: Ottawa University (Power System Solutions)[27]

The twelve buildings of Ottawa University encompass almost 300,000 square feet and were built beginning in the late 1800s. The facility management staff at the University learned about the availability of energy efficiency services through energy publications, and sought an ESCO proposal designed to reduce the university's energy costs. From the perspective of the University's administration, energy cost reductions offered the opportunity to increase expenditures on present academic programs, as well as the chance to reduce the impact of rising energy costs in the future.

After selecting Power System Solutions (PSS) for this work, the University took approximately two months to negotiate a contract with PSS for a comprehensive energy audit and a comprehensive retrofit of all energy systems at the University. The audit revealed annual energy consumption of over three million kWh and 32,753 MCF.

[27] Ottawa University, 1001 S. Cedar, Ottawa, Kansas 66067; Power System Solutions, 9185 Bond, Overland Park, Kansas 66214.

Following the audit, PSS undertook the design and installation of the project, completing its work in approximately eight months. This project included the installation of high-efficiency lighting, occupancy sensor controls, new natural gas boilers, reciprocating chillers, variable-frequency drives, and an energy management system, all designed to reduce both electric and gas usage.

PSS was able to reduce the University's gas bill alone by more than $10,000 per year through the application of scheduled on/off controls on the heating equipment, the staging of gas-fired boilers, and a night temperature setback program through the centralized energy management system. In addition, the large multizone HVAC unit serving the student union building had previously been allowed to simultaneously heat and cool the facility. The energy management system was programmed to prevent this and to schedule heating and cooling on a preset basis. Through these applications, PSS was able to reduce energy consumption at the University by 920,000 kWh and 5009 MCF annually, freeing up over $70,000 per year for the Ottawa's academic programs.

Addressing Energy Savings and Building Comfort

Commercial and industrial facilities and public institutions of almost any type can benefit from energy efficiency upgrades. One category of facilities where energy use is substantial, and indoor comfort and environmental quality are crucial, is hospitals. As the following case studies demonstrate, energy efficiency retrofits can be applied to address both energy savings and comfort in the facility, and can be accomplished without interrupting critical hospital functions.

Case Study 18: Lima Memorial Hospital (Honeywell)[28]

Faced with an old and inefficient physical plant that rendered the maintenance of satisfactory temperatures in the hospital exceedingly difficult, Lima Memorial Hospital recently sought a means of financing the upgrade of its three-building, 450,000 square feet facility. Lima had worked with Honeywell in the past and therefore sought advice from the company.

After conducting a comprehensive energy audit of the facility, Honeywell recommended the installation of new chillers and boilers due to the age of the existing equipment. Honeywell's recommended project design also called for an upgrade to the cooling system, a complete lighting retrofit, the replacement of the facility's steam traps and the installation of an energy management system.

[28] Lima Memorial Hospital, 1001 Bellefontaine Avenue, Lima, Ohio 45804; Honeywell Inc., Honeywell Plaza, P.O. Box 524, Minneapolis, Minnesota 55440-0524.

Lima and Honeywell negotiated a contract for the project in two months, and Honeywell completed the installation in approximately nine months. The installation required that Honeywell virtually rebuild the boiler and chiller plant while keeping operations running and shutdown to a minimum, ensuring a continuously healthful and safe environment for patients and staff.

Honeywell provided third-party financing for the project and, under its five-year contract with Lima, provides a guarantee of energy and operational savings to Lima totaling $446,636 per year. As a result of the project, patient and employee comfort levels at the hospital have been improved substantially, and to date, Lima's energy savings have exceeded the guaranteed level.

Case Study 19: St. John Medical Center (Johnson Controls)[29]

St. John Medical Center is a 1.2 million-square-foot facility that has actively served the people of Tulsa and the surrounding communities since 1926. In the late 1970s and early 1980s, the administration at St. John began taking steps toward becoming a more energy-efficient operation. They developed a task force that included hospital employees from plant operations, engineering and maintenance departments.

Over the past several years, St. John has worked closely with a Johnson Controls project team to implement 42 energy conservation measures. These include improved boilers; chillers; variable speed pumps; economizers; and high-efficiency fans, motors and air distribution systems. In addition, Johnson Controls upgraded the computerized Facility Management System it previously had installed at St. John. The new system allows the facility's engineers to operate the facility from a central location. The Johnson Controls and St. John teams also developed a Standard Operating Procedure backed by the administration for dealing with patient, visitor and staff comfort.

Financing for the project included nine energy improvement grants from the Department of Energy, totaling approximately $900,000. With this assistance, the project was financed without competing for funds that directly impact patient care.

This project has resulted in a utility savings exceeding $9 million for St. John. It also has enabled the Medical Center to expand energy services to an additional 200,000 square feet of space without increasing utility costs or adding physical plant staff. According to Charles Johnson, vice president of St. John Medical Center, "Every dollar we save through efficient use of energy is a dollar we can spend towards improved patient care and comfort. Because

[29] St. John Medical Center, Tulsa, Oklahoma; Johnson Controls, Controls Groups, 507 East Michigan Street, Post Office Box 423, Milwaukee, Wisconsin 53201-0423.

we faced staggering utility bills, the recommendations presented by our energy task force made good economic sense for our institution. We feel we have done a great job identifying the areas in need of improved energy efficiency. Through proper documentation and the budgeting process, we have been able to upgrade equipment throughout our facility and central plant."

Addressing Indoor Air Quality Through Energy Efficiency Upgrades and Disposing of Project Hazardous Waste

These case studies readily reveal the great potential for reducing energy consumption and costs offered through energy efficiency retrofits. Increasingly, the environmental benefits of reduced utility emissions are being recognized as a benefit of comprehensive energy efficiency projects as well. In addition to these recognized benefits of energy efficiency, the ESCO industry routinely provides for the environmentally appropriate disposal of equipment removed during a retrofit—much of which contains hazardous waste such as mercury, PCBs and in some cases asbestos. Energy efficiency retrofits also can be used to address facility concerns related to indoor air quality.

The final case study, of a project undertaken by NORESCO for the Duxbury School District, demonstrates the use of an ESCO and an energy efficiency retrofit to address a serious indoor air quality problem in Duxbury's schools and to provide for the removal and disposal of a number of hazardous materials from the school buildings.

Case Study 20: Duxbury Public Schools (NORESCO)[30]

The four buildings in the Duxbury Public School system covered by the NORESCO project were built between 1940 and 1970, and include a total of 480,000 square feet. Due to the lack of a maintenance program at Duxbury Public Schools, the capital equipment in the buildings, particularly the high school, had deteriorated to a point beyond repair. In recent years, indoor air quality in the school buildings, especially the high school, became a significant public issue for the School District.

When Duxbury solicited proposals for a company to address its air quality problems on an expeditious basis, NORESCO, with an energy efficiency retrofit that addressed both energy use and indoor air quality, was one of the three respondents. After selection and a thirty-day contract negotiation, Duxbury conducted a comprehensive energy audit and undertook project design and installation, all within a period of 54 days to meet the School District's need to expedite a cure for the indoor air quality issues.

[30] Duxbury Public Schools, 130 St. George Street, Duxbury, Massachusetts 02332; NORESCO, Point West Place, 111 Speen Street, Framingham, Massachusetts 01701.

The measures installed by NORESCO included an energy-efficient lighting retrofit, the installation of energy-efficient motors and variable speed pumping systems, the installation of a centralized energy management system, as well as the conversion of two of the school buildings from electric to oil heat. Ventilation systems in the other buildings were upgraded.

The conversion to oil heat in the two buildings with the most acute indoor air quality problems enabled NORESCO to bypass the seriously degraded ventilation systems, the principal source of the air quality problem, while reducing Duxbury's energy bill. The longer payback for the new heating systems is cross-subsidized by the short payback on the lighting retrofit, which also benefitted from a rebate from Commonwealth Electric Company.

The resulting $2.7 million project, financed through a third party brought in by NORESCO, is being paid for by the School District under a 10-year shared savings contract with NORESCO. During the 10-year contract period, NORESCO guarantees Duxbury an energy cost savings of $271,900 per year. NORESCO also provides ongoing maintenance, as well as measurement and verification of Duxbury's energy savings using the measurement and verification protocol developed by Commonwealth Electric Company.

In addition to the improved indoor air quality and the energy savings of 2.4 million kWh and 32,000 gallons of oil per year produced by this project, NORESCO provided for the removal, transportation and environmentally appropriate disposal of asbestos, fluorescent lamp ballasts containing PCBs and fluorescent lamp tubes containing mercury. In order to accomplish the removal and disposal of these hazardous materials, NORESCO and other ESCOs must provide for appropriately qualified subcontractors to handle the asbestos. PCB ballasts and lamps must be removed, packed and transported according to strict federal and state regulations, requiring licensing and manifesting. Disposal of these materials also is subject to federal and state regulations, including the federal statutes governing Superfund and the Resource Conservation and Recovery Act (RCRA).

At Duxbury the cost for removal, transportation and disposal of the asbestos, PCB ballasts and mercury-containing lamps added $35,000 to the cost of the project. As with other project costs, this amount is folded into the overall project financing and covered by NORESCO's energy savings guarantee.

CONCLUSION

As Joseph Romm noted in his review of American energy policy, "it is a woeful misconception that the pursuit of greater energy efficiency must come at the expense of economic growth." As these case studies demonstrate, energy efficiency offers a very real and readily available means of promoting economic growth and enhancing our economy's competitiveness. It also is clear that the economic and environmental benefits afforded by the energy-efficient renovation of existing buildings are readily available through the Energy Services Industry. Whether the issue is one of identifying opportunities for energy savings, financing a project or taking that crucial step from concept to implementation, ESCOs offer the necessary expertise and services. In project after project, we see companies entering into energy efficiency partnerships with their customers, tailoring financial packages, looking for the optimal project design, and often pushing the technological envelope in order to deliver the greatest level of energy savings possible. These companies are at the forefront of managing America's transition to a more energy-efficient, cost-competitive economy.

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